SCIENCE ABSTRACTS.

Section A.—PHYSICS.

SEPTEMBER, 1927.

GENERAL PHYSICS.

2431. *Theory of the Isochronous Pendulum.* **H. Bock.** (Zeits. Instrumentenk. 47. pp. 241–249, May, 1927.)—In continuation of his previous paper [Abstract 266 (1927)], the author first works out the theory of a cycloidal isochronous pendulum, and then makes two attempts to elucidate the function of the flat spring suspension in conferring isochronism on a pendulum. A. H.

2432. *New Pendulum with Constant Time of Oscillation.* **M. Schuler.** (Zeits. f. Physik, 42. 7. pp. 547–554, 1927.)—To determine accurately whether changes occur in the rate of rotation of the earth or in the local value of g very accurate time measurements are essential. To eliminate errors due to displacement of the point of support a pendulum rod of invar was used with brass weights at each end. The length of the simple equivalent pendulum is arranged to be double the distance between the point of support and the centre of gravity. The pendulum swings in an enclosure filled with hydrogen and is controlled by a small electromagnet at the top. The accuracy is equal to 1 in 10^7. It is shown how one can eliminate errors due to amplitude and friction. R. S. R.

2433. *The Jet-Wave Accelerometer Attached to a Pendulum.* **J. Hartmann.** (Phil. Mag. 3. pp. 1073–1085, May, 1927.)—A liquid jet is substituted for the flame in the instrument described by K. Prytz [see Abstract 2359 (1923)]. The theory is worked out in detail and experimentally tested by attaching a jet-wave accelerometer to a pendulum and determining (*a*) the phase-difference between the jet and the pendulum; (*b*) the amplitude of the relative motion of the jet. Satisfactory agreement between experiment and theory is obtained. E. G.

2434. *Mathematical Theory of the Michell Ball Viscometer, with Observations Relating to its Design, Construction and Operation.* **R. O. Boswall.** (Phil. Mag. 3. pp. 994–1006, May, 1927.)—From a purely theoretical standpoint the Michell viscometer may be regarded as a precision instrument, but it can only be applied to measure viscosity over a range of temperature with any degree of accuracy if the following conditions of a practical character are more or less closely fulfilled. In order that the constant may change as little as possible with change of radius, the projections used for regulating the initial film thickness at the centre of the cup must be spaced correctly to suit the initial difference in radius and the height of projection. Cup and ball should be of similar material to avoid unequal expansion, and the cup-mounting should have such a shape that irregular expansion or distortion may be reduced to a minimum. The instrument should be calibrated with an oil or other liquid of known viscosity over a range of temperature, any variation of the constant being noted. Other things being equal, a low-constant instrument should give better accuracy than one with a constant exceeding about 40. A high-constant instrument should not be used for thick or highly viscous liquids and, in any case, the fluid should be strained or allowed to stand to permit foreign matter to settle. When a series of observations over a range of temperature is taken, special care is necessary that the rate of cooling is very slow and the temperature uniform throughout the liquid in the bath. The depth to which the instrument is immersed in the bath does not affect the accuracy, provided that the edge of the cup is completely covered. T. H. P.

2435. *Fixed Point for the Calibration of Pressure Gauges. The Vapour Pressure of Liquid Carbon Dioxide at 0° C.* **O. C. Bridgeman.** (Am. Chem. Soc., J. 49. pp. 1174–1183, May, 1927.)—The vapour pressure of liquid carbon dioxide at the ice point was found to be $34 \cdot 4009 \pm 0 \cdot 0013$ atmos. ($g = 980 \cdot 665$) by measurement with piston gauges, previously calibrated against a mercury column. It is suggested that the carbon dioxide liquid-vapour system at the ice point is suitable for adoption as a definite calibration point for pressure gauges since it satisfies the requirements as to accuracy, simplicity and ease of manipulation. L. M. C.

2436. *A McLeod Gauge with Solid Piston.* **E. Brüche.** (Zeits. techn. Physik, 8. 5. pp. 184–188, 1927.)—A description is given of a McLeod gauge in which only a relatively small quantity of mercury is required as compared with a gauge of the same capacity but of the ordinary construction. Mercury is saved by employing a glass piston partly supported by a spiral steel wire spring, the mercury being used solely as a sealing liquid. The advantages and disadvantages of the gauge as regards facility of construction and use are detailed. T. B.

2437. *The Aspiration Psychrometer.* **H. Ebert.** (Zeits. f. Physik, 43. 5–6. pp. 335–341, 1927.)—An apparatus was devised by which the readings of humidity obtained from the Assmann psychrometer can be compared directly with those of an absorption hygrometer. The results obtained are tabulated for (1) absorption method, (2) author's tables [see Abstract 1175 (1926)], (3) Sprung's formula, and (4) Svensson's formula. Readings were obtained from 20° C. to 120° C. with different relative humidities. At higher temperatures and with greater psychrometer differences deviations from the theoretical value occur with both methods, but it is shown that with the tables given, the Assmann aspiration psychrometer is reliable up to 120° C. R. S. R.

2438. *A Gas Analysis Instrument Based on Sound Velocity Measurements.* **E. Griffiths.** (Phys. Soc., Proc. 39. pp. 300–303; Disc., 303–304, June, 1927.)—The instrument described is based on a principle which has not hitherto been utilised in the design of gas analysis instruments. A quartz crystal is maintained in vibration piezoelectrically, and stationary waves are set up in the gas between the flat surface of the crystal and a movable reflector. The position of the nodes is recognised by the reaction on the quartz crystal, resulting in an increase of the current in the maintaining circuit. The distance from node to node is a measure of the composition of the gaseous mixture, assuming it is composed of two gases which do not react. AUTHOR.

2439. *Generation of Vortices in Fluids of Small Viscosity.* **L. Prandtl.** (Engineering, 123. pp. 627–628, May 27, 1927. Wilbur Wright Memorial Lecture read before the Roy. Aeronaut. Soc., May 16, 1927.)—The author describes the generation of vortices in slightly viscous fluids, and first deals with the contradiction that while observation proves vortices to be rapidly formed in slightly viscous fluids, Lagrange's theorem states that no element of a perfectly inviscid fluid can ever be set in rotation. It is shown that every confluence at a sharp edge can give rise to a surface distribution of vorticity without contradicting Kelvin's theorem that in a homogeneous frictionless fluid the circulation along every closed fluid line did not vary with the time. The case is then discussed of a circular cylinder moving through a fluid and is illustrated by twenty-nine photographs. It is pointed out that the formation of turbulent boundary layers makes it possible for the flow over aerofoils, propellers and airship hulls to follow the boundary almost to the trailing ends. These turbulent flows of low resistance round bodies enable the general character of the flow round an obstacle to be closely represented by the theory of a perfect liquid. H. H. Ho.

2440. *Capillarity Experiments with Jellies.* **K. Schultze.** (Kolloid Zeits. 42. pp. 3–9, May, 1927.)—The author gives further information [see Abstracts 864 and 1243 (1927)] on the technique of these experiments. The blocks of agar-gelatine jelly are either provided with surface grooves (open capillaries, knife cuts), or lead wires and steel bars are embedded in the hot liquid mass and withdrawn after solidification (closed capillaries). Tubular capillaries are also obtained by piercing the jelly with a cork bore and withdrawing the solid cylinder. The blocks are placed in solutions of organic dyes or of potassium permanganate and of iodine (in potassium iodide), and then cut up to trace the advance of the dye; the blocks must be kept in moist atmospheres to prevent shrinking. Paper prints are easily obtained; the dye does not accumulate in the apex of a sharp angle. Blocks can further be prepared by mixing hot liquid agar with 30 to 50 % of paraffin oil or molten paraffin; when dry this mass is not wetted by water and does not allow aqueous solutions to rise. Organic solutions of sudan in organic solvents rise only in the oil drops close to the walls of the capillary. H. B.

2441. *Rigidity of Solid Unimolecular Films.* **H. Mouquin** and **E. K. Rideal.** (Roy. Soc., Proc. 114. pp. 690–697, May 2, 1927.)—On evaporation at low temperatures of a benzene solution of palmitic or stearic acid on the surface of water, an apparently solid film is left which Langmuir and Adam have shown to be unimolecular in character. The rigidities of these two films have now been determined and the constants found to be almost identical, *viz.*, $4 \cdot 9 \times 10^7$ dynes per cm.^{2} at 20° C.

The temperature coefficients of the rigidities have also been measured and found to be of a character anticipated for waxy solids. Full details are included of the experimental method employed, which enabled the indirect application of a tangential force to each point on the whole surface of the film, and which consisted essentially of rotating a disc immediately under the surface of the film, thereby exerting a drag on it through the intermediary of the viscosity of the water. H. H. Ho.

2442. *Internal Friction in Solids.* **A. L. Kimball** and **D. E. Lovell.** (Mechanical Engineering, 49. pp. 440–442; Disc., 442–444, May, 1927.)—The deflection in an overhung shaft, supporting by ball bearing a load at the end, was measured. When the shaft was rotating there was, in addition to the vertical deflection, a horizontal deflection caused by the stresses set up by internal friction and proportional to them. It was found that the magnitude of this side deflection was sensibly independent of the speed, so that the frictional forces are not, like viscous forces in liquids, proportional to the rate of strain. They are, in fact, proportional to the strains. It is suggested that the effects may be represented by the formula $F = \xi f_m^2$, F being the energy loss per unit volume per cycle, ξ a constant for the material, and f_m the maximum stress. Values of ξ as deduced from the experiments are given. The independence of ξ on the speed was checked by vibration experiments. The discussion was mainly an account of cognate work, notably that of Mason and Bennewitz. W. G. B.

2443. *Some Results of an Experimental Study of Substances having Considerable Internal Friction.* **B. Weinberg.** (Indian Journ. Phys. 1. pp. 279–310, May, 1927.)—Previous work [see Abstract 2238 (1926)] dealt with the complexity of the phenomena relating to the transformations of solids under the action of stresses exceeding the limit of elasticity. This paper contains a detailed examination of different methods employed for the determination of η, *viz.*, simple or helicoidal torsion, spiraliform torsion, shearing of a parallelepiped, shearing of two adjacent parallelepipeds, shearing of a tore, axial shearing of a cylindrical layer, and flow in a tube under the action of gravity. H. H. Ho.

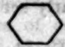
2444. *Increase of Belt Tension due to Bending Round a Pulley.* **R. Swyngedauw.** (Comptes Rendus, 184. pp. 1316–1318, May 30, 1927.)—The increase of belt tension due to bending round a pulley can easily be demonstrated with a rubber belt. If such a belt about 4 mm. thick is used to couple two pulleys 20 cm. diameter, the relative increase of velocity of an element of the external face of the belt is found by the stroboscopic method previously described [Abstract 1216 (1926)] to be about 4 %. This involves an increase of the total tension of the belt, due to the bending, of about one-tenth. Simple formulæ for the increase of tension are deduced and results calculated for leather and balata belting. A. W.

2445. *Poisson's Law and Hugoniot's Equation.* **O. Klüsener.** (Zeits. f. Physik, 43. 8. pp. 597–600, 1927.)—An explanation of the temperature changes when a wave impulse travels through a gas according to the Hugoniot equation. A comparison is effected with the values obtained by the Becker equation [see Abstract 1481 (1922)]. It is pointed out that friction and conduction of heat along the wave front must be considered. The values obtained are set out both in curves and comparative tables with the Becker values. S. G. B.

2446. *Theory of Crystal Growth.* **H. Brandes.** (Zeits. phys. Chem. 126. 3–4. pp. 196–210, April, 1927.)—The earlier work is critically discussed in order to arrive at a physical explanation of the different velocities of crystal growth. A new theory is developed, which involves the mathematical consideration of the vapour pressure and energy of formation of a two-dimensional nucleus, the form of the nucleus, the tension at the boundaries of the nucleus, and the results are applied to the case of the cube and the octahedron. The mathematical conclusions are in satisfactory agreement with the results of experiment. F. J. B.

2447. *Crystal Structure of Benzil.* **N. C. B. Allen.** (Phil. Mag. 3. pp. 1037–1040, May, 1927.)—The examination was made on the ionisation spectrometer. $C_6H_5CO.COC_6H_5$ is trigonal trapezohedral (rhombohedral enantiomorphy). $a = 8 \cdot 42$ Å.; $c = 13 \cdot 75$ Å.; density $= 1 \cdot 23$; space-group D_3^4 (or D_3^6); unit cell contains three molecules, each having a dyad axis, disposed spirally about the principal axis consistent with the optical activity. The results of Becker and Rose [Abstract 1589 (1923)], *i.e.*, $a = 8 \cdot 15$ Å., $c = 13 \cdot 46$ Å., density $= 1 \cdot 38$, are inconsistent with the results of the present experiments. W. H. Ge.

2448. *Some Theoretical Determinations of Crystal Parameters.* **J. E. Lennard-Jones** and **Beryl M. Dent.** (Phil. Mag. 3. pp. 1204–1227, May, 1927.)—The parameters of the entire group of crystals have been calculated on certain assumptions which (in contrast to those of Born and Bollnow) indicate a variation from crystal to crystal which is in agreement with experiment. On the other hand, calculations of the parameters for K_2PtCl_6 and K_2SnCl_6 give equal values where the experimental values $0 \cdot 17$ and $0 \cdot 245$ differ by 50 %. Similar calculations on the assumption that carbon dioxide is composed of C^{++++} and O^{--} ions lead to a distance between these atoms which agrees with the crystal parameters determined by Smedt and Keesom, but not with those determined by Mach and Pohland. [See Abstract 1639 (1927).] T. M. L.

2449. *Crystal Structure of Lower ω-Phenyl Normal Saturated Fatty Acids.* **A. L. Patterson.** (Phil. Mag. 3. pp. 1252–1262, June, 1927.)—The examination was made chiefly by the rotation and Laue methods. The general formula is  $(CH_2)_nCOOH$. *Phenylacetic Acid* ($n = 1$) monoclinic; $\beta = 101°$; density = ?; probable unit cell $a = 14 \cdot 2$ Å., $b = 4 \cdot 90$ Å., and $c = 10 \cdot 1$ Å., containing four molecules; probable space-group $C_{2h}^5(b)$. *β-Phenylpropionic Acid* ($n = 2$) monoclinic prismatic; $\beta = 101° 13'$; $a = 32 \cdot 2$ Å., $b = 9 \cdot 83$ Å., and $c = 5 \cdot 54$ Å.; density $= 1 \cdot 142$; this unit cell contains eight molecules; probable space-group $C_{2h}^5(a)$; some ionisation spectrometer readings are given. *γ-Phenylbutyric Acid* ($n = 3$) monoclinic; $\beta = 98° 30'$; $a = 17 \cdot 8$ Å., $b = 4 \cdot 90$ Å., and $c = 10 \cdot 3$ Å.; density = ?; this unit cell contains four molecules; probable space-group $C_{2h}^5(b)$. *δ-Phenylvaleric Acid* ($n = 4$) monoclinic; $b = 7 \cdot 13$ Å., $c = 11 \cdot 32$ Å., and $d_{100} = 8 \cdot 73$ Å.; four molecules in the unit cell. The structure of this member bears no simple relation to that of the others. It would appear that the series finally settles down to a double series of alternating odd and even numbered acids similar to the fatty acids themselves. W. H. Ge.

2450. *The Cleavage of Rock-Salt Parallel to Rhombic Dodecahedral* (110) *and Octahedral* (111) *Surfaces,* **W. D. Kusnezow.** (Zeits. f. Physik, 42. 11–12. pp. 905–909, 1927.)—Shows experimentally that, when an attempt is made to produce cleavage in a (110) plane, the surface produced consists of a series of steps, bounded by (100) planes at right angles to one another. 1·76 times as much energy would be required to produce a perfect (110) cleavage as is needed for the actual stepped surfaces obtained. In the case of the (111) planes the surfaces produced are covered with pyramidal hillocks and pits, the surface of which are (100) planes. The energy required for perfect cleavage in this case would be 3·36 times as great as for that actually obtained. H. N. A.

2451. *X-Ray Study of Artificial Ultramarines.* **F. M. Jaeger, H. G. K. Westenbrink** and **F. A. van Melle.** (K. Akad. Amsterdam, Proc. 30. 2. pp. 249–267, 1927.)—Powder photographs of the ultramarines Guimet I–V, a number of German ultramarines and the minerals *nosean* and *hauyne* were *all* completely identical and were interpreted to give a body-centred cell containing one molecule of an ultramarine or two molecules of nosean ($Na_5Al_3Si_3O_{16}S$). Studies were then made of *sodalite*, *lazurite* and *nephelite*, and many comparisons were made. The work appears to be set out chronologically, and the original paper should be consulted. Further discussion is promised later. W. H. Ge.

2452. *X-Ray Photo-Goniometry.* **J. D. Bernal.** (Journ. Sci. Instruments, 4. pp. 273–284, June, 1927.)—Part I of a series of papers in which it is proposed to treat the general problem of the requirements and capabilities of apparatus for the different methods of X-ray crystallography and to describe in detail a new universal photo-goniometer (X-ray spectrometer in which photographic methods are used to detect the X-rays), together with an account of its adjustment and use. The present part discusses briefly (1) the crystal lattice, planes and symmetry, and their influence on X-ray diffraction; (2) the routine of X-ray crystallography; (3) the essentials of the X-ray photo-goniometer; and (4) theory of the rotation method [see Abstract 883 (1927)]. In an excellent table the advantages and disadvantages for various purposes of *all* the current methods of X-ray crystallography are clearly set out. W. H. Ge.

2453. *X-Ray Study of Solid and Fused Para-Azoxyanisols.* **W. Kast.** (Ann. d. Physik, 83. 3. pp. 418–426, June 16, 1927.)—An X-ray study of the size and orientation of the particles of solid and fused *p*-azoxyanisols between the plates of a condenser in a magnetic field. W. H. Ge.

2454. *Tensile Tests on Alloy Crystals.* **C. F. Elam.** (Roy. Soc., Proc. 115. pp. 133–169, June 1, 1927.)—Part I contains the results of experimental work on solid solution alloys of aluminium and zinc containing from 5 to 18 % zinc. Large crystals were grown by straining to an extension of 1 or 2 % with a previous and subsequent annealing at

500–550°. Tensile tests on the alloys in a multicrystalline state and as single crystals show a higher breaking load and lower extension prior to fracture as the zinc is increased. An account of distortion and X-ray measurements on a few of the best single crystals is given. Part II contains the results of similar work to the above on solid solution alloys of copper and zinc, the single crystals being produced by slowly lowering graphite tubes containing a rod of 70/30 brass through an electric furnace at such a rate that cooling and solidification begins from the bottom of the tube. A full description of distortion and X-ray measurements of three separate crystals is given. Part III gives the conclusions arrived at from the investigations. In the case of the Al-Zn alloys, a rapid rise in shear stress with increasing zinc is noted, and as the extension proceeds the increase in shear stress for the same amount of shear does not differ to anything like the same extent. This seems to indicate that the zinc atoms affect the initial yielding of the metal to a greater extent than the hardening process due to deformation. The results obtained with the brass crystals are directly opposite to those of Al-Zn alloys in many respects, but these differences may be due to different methods of preparing single crystals used. In both these systems the nature of the slip bands is very much altered by the addition of zinc. C. O. B.

2455. *Magnetism and the Periodic System.* **R. Ladenburg.** (Zeits. phys. Chem. 126. 1–2. pp. 133–152, April, 1927.)—A compilation of facts relating to electrons and atomic structure is first set forth. The electrons in an atom are distinguished by a quantum number *n*, an auxiliary number *k*, and an inner quantum number *j*. In general, an atom has many electrons belonging to any *n* group; these fall into *k* sub-groups where *k* is never greater than *n*. The electrons in the same sub-group are distinguished by means of Sommerfeld's inner quantum number *j*, as in those which produce the D-line doublet; *j* may have one of two values which are connected with the two possible directions of spin of the electron. A table of the periodic system is made up, giving the atomic numbers, and distinguishing paramagnetics from diamagnetics. The valency of the ion is indicated, also the total number of electrons in the atom and in the ion. The ions of the first twenty-one elements are all diamagnetic. The first paramagnetic ion is Ti . . . and it is also the first which contains an incomplete sub-group of electrons. Paramagnetism is thus related to incompleteness of the sub-group, and the principle is stated: Only those ions are paramagnetic in which the electrons form an incomplete sub-group; all simple ions whose sub-groups contain the maximum number of electrons are diamagnetic. As a test of this law, the magnetic properties of certain saturated pure compounds of the elements Nos. 21–25, 39–42, 57, 58, 71–74 and 92 have been investigated. According to the principle, all the substances should be diamagnetic, but the values found for the mass susceptibility are in some cases greater, in others less, than unity. It is considered that, of the compounds investigated, probably only Sc, Ti, Y and Ia are diamagnetic, these being known to have free ions of maximum valency. This is not known of the others, all of which have, in the compounds investigated, a probable positive susceptibility of abnormally small value. G. E. A.

2456. *Limits of the Periodic System of the Elements.* **E. Meyer.** (Zeits. Elektrochem. 33. pp. 189–192, May, 1927.)—The possibility of the existence of a lighter element than hydrogen or a heavier one than uranium is discussed in the light of Bohr's view on the structure of the atom. T. H. P.

2457. *Velocity Selector for Atomic Rays.* **J. Tykocinski-Tykociner.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 423–430, May, 1927.)—The description of an apparatus for selecting atoms of particular velocities from atomic and molecular rays is given. The theory of the action of the apparatus is outlined, and the characteristics of expected spectrum-like images are discussed. An atomic ray on its way towards a chemically active target is conveyed through two vibrating slits at a distance D apart. The vibrations are controlled by the oscillating current of an electron tube. The emerging ray contains selected velocities. For very small ratios of the width w of vibration to the amplitude of the slit a, the selected velocities are determined by $v_n = 2\mathrm{D}f/n$, where f is the frequency of vibration and $n = 0, 1, 2, 3$, etc. For larger w/a ratio a great number of velocity bands are obtained each embracing a range

$$v'_n - v''_n = 2\mathrm{D}f\left[\frac{1}{n - w/2\pi a} - \frac{1}{n + w/2\pi a}\right].$$

When used in connection with the Gerlach and Stern magnetic moment analyser, images should be obtained consisting of n pairs of lines, whose thickness is

$$d_n = \frac{1}{4}\frac{\mathrm{M}}{m}\left(\frac{\delta \mathrm{H}}{\delta \mathrm{S}}\right)_0 \frac{l^2}{\mathrm{D}^2}\frac{n}{f^2}\frac{w}{\pi a}\left(\mathrm{K} + \frac{1}{2}\right).$$

An example for a hydrogen atom ray at 500° K is calculated. AUTHOR.

2458. *Atomic Properties which make an Element a Metal.* **K. F. Herzfeld.** (Phys. Rev. 29. pp. 701–705, May, 1927.)—From the dielectric constant of a gas or from its refractive index, extrapolated to long wave-lengths, the molar refractivity R can be calculated. In the solid or liquid state we have $(n^2 - 1)/(n^2 + 2) = \mathrm{R}d/\mathrm{M}$. The left side cannot be larger than 1. If the right side becomes larger than 1, the dispersion electron is set free, and the body then has metallic conductivity. The necessary and sufficient condition for metallic conductivity is therefore $\mathrm{R} > \mathrm{M}/d$. The prediction is verified in the case of metals for which the refractive index is known or for which it can be calculated. It is shown that the condition is probably satisfied in the case of metals for which the refractive index cannot be calculated with certainty. The conductivity of sodium dissolved in liquid ammonia is discussed.

AUTHOR.

2459. *Structure of the Electronic Groups in the Atom. Part II.* **H. Lessheim** and **R. Samuel.** (Zeits. f. Physik, 42. 8. pp. 614–626, 1927.)—Part I of this investigation [see Abstract 1265 (1927)] is now extended by treatment of the elements Y to Pd and La to Pt. It is found that these elements are also characterised by a definite electronic configuration determined by three quantum numbers, which must in consequence be regarded as the normal condition. The results of both investigations are summarised and discussed. H. H. Ho.

2460. *Terms Arising from Similar and Dissimilar Electrons.* **R. C. Gibbs, D. T. Wilber** and **H. E. White.** (Phys. Rev. 29. pp. 790–793, June, 1927.)—Following the scheme of Hund for similar *s*, *p* and *d* electrons the terms arising from similar *f* electrons have been worked out and tabulated. Tables have also been prepared for one and two electrons, where in the latter case these electrons are dissimilar, *i.e.*, have either different total or different azimuthal quantum numbers, and also for three electrons two of which are similar. These tables along with those for similar *s*, *p* and *d* electrons are found not only to be of frequent use, but also to bring out certain rules that may be applied in determining spectral terms arising from any electron configuration. AUTHORS.

2461. *Effective Area of Hydrogen and Nitrogen Molecules for Slow Electrons.* **E. Brüche.** (Ann. d. Physik, 82. 7. pp. 912–946, April 29, 1927.)—Continues the investigation described in a recent paper [see Abstract 302 (1927)], using instead of the previous method, with a rectilinear trajectory, one similar to that of Ramsauer, in which the electrons are bent by a magnetic field so as to pass through a series of slits arranged so that only electrons with a circular trajectory are effective. The quantitative measurements were carried on to the lower limit of the two-cage method, or down to $\sqrt{\text{volts}} = 1 \cdot 5$. Two other ways of using the magnetic method were developed, by means of which the range between $\sqrt{V} = 1 \cdot 5$ and $\sqrt{V} = 1$ was studied; one of these, by comparison of the curves of velocity distribution with and without gas, revealed the existence and the position of maxima, as in the case of oxygen; the other was a one-cage method. Above $\sqrt{V} = 2$ the curves obtained are practically identical with those obtained previously, and below this value the differences are small. H. N. A.

2462. *Increase in Frequency of Light Quanta due to Collisions with Rapidly Moving Material Particles.* **A. Haas.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 10. pp. 647–653, 1926.)—The author has previously pointed out that the Compton effect may provide a possibility for the transformation of starlight into matter, which may be of cosmic importance. A quantum before it can transform into matter (an electron and a proton) must certainly have as much energy as a hydrogen atom, and so must have at least a certain critical frequency, which corresponds to a wave-length of 0·013 X or $1 \cdot 3 \times 10^{-13}$ cm. The formula of de Broglie for change in wave-length due to the Compton effect is employed, and numerical calculations are made of the changes produced by collisions with various velocities of the colliding material particle, which is supposed to move in the opposite direction to the light quantum. It is shown that for velocities in the neighbourhood of *c*, a quantum of low frequency will have its frequency raised above the critical value. H. N. A.

2463. *Orbits and Light Radiation of Hydrogen Electrons.* **T. Engset.** (Ann. d. Physik, 82. 8. pp. 1017–1024, May 12, 1927.)—Continues the treatment of the two previous papers [see Abstract 303 (1927)]. In the present paper the relation between the azimuthal quantum number (rank number of the impulse moment), *k*, the principal quantum number (rank number of the energy steps), *n*, and the lengths of the major and minor axes of the orbit is worked out. $b/a = 2k/n$, so that when $2k = n$ the ellipse becomes a circle, and *k* can in no case be greater than $n/2$. A more general relation between the frequency of radiation and *k* than that found in the previous paper is looked for, the orbits between which the jumps occur being taken first as both circular, then one circular and one elliptic, and finally both elliptic. It is shown that there is a formal relation in these cases between the classical upper partial vibrations and the frequencies. **Errata** (*ibid.*, 83, 6. pp. 903–904, July 20, 1927). H. N. A.

2464. *Pendulum Orbits in Atomic Models.* **R. B. Lindsay.** (Nat. Acad. Sci., Proc. 13. pp. 413–419, June, 1927.)—Pendulum orbits have usually been ruled out of the system of actual orbits because of involving collision of the electron with the nucleus, nevertheless the fact that the energy of an electron orbit may depend only on the principal quantum number suggests their possibility. Pendulum orbits have been investigated by Nicholson [see Abstract 1764 (1923)], but his reasoning is now shown to involve error. The present paper investigates the conditions under which a pendulum orbit quantised according to $\oint p_x dx = nh$ is possible, and for this purpose the inverse cube force law has been assumed from which qualitative inference may be drawn of the effect of introducing a more complicated law. The paper concludes with a few remarks concerning the relation between the kind of pendulum orbit described and the newer theories of atomic structure. H. H. Ho.

2465. *Coupling of Electronic and Nuclear Motions in Diatomic Molecules.* **E. U. Condon.** (Nat. Acad. Sci., Proc. 13. pp. 462–466, June, 1927.)—Deals with the following problems: (1) The dissociation of molecules by light absorption; (2) dissociation as a primary consequence of excitation by electron collision; (3) intensity distribution in electronic band systems; (4) the excitation of molecules to vibration levels by electron collision, without simultaneous electronic excitation. Assumes that the heavy masses of the nuclei bring about a partial separation of the variables in Schrödinger's equation; this requires that the energy levels (eigenwert parameter) should be the sum of a function depending only on the electronic quantum numbers, denoted in the aggregate by e, and a function of both the electronic quantum numbers and a vibrational quantum number, n; also that the amplitude function, ψ, should be the product of two factors, one depending on all the quantum numbers and the nuclear separation R, and the other on the electronic quantum numbers and the electronic and nuclear coordinates. The result of a numerical calculation of the intensities of the n' progression of the Schumann-Runge bands of oxygen shows a good semi-quantitative agreement with Runge's measurements. H. N. A.

2466. *Statistical Mechanics and its Application to Physical-Chemical Problems.* **R. C. Tolman.** (Frank. Inst., J. 203. pp. 661–678, May, 1927.)—It was concluded in a previous paper [see Abstract 1974 (1927)] that a micro-canonical ensemble of systems distributed uniformly in the phase space with energies between E and E + dE, gives a fair representation of the successive states of a single system left to itself with energy in that range. The present paper contains applications of this result to systems in equilibrium which are considered under: The Maxwell-Boltzmann Distribution Law; The Maxwell Distribution Law; Collisions with Walls and between Molecules; Averages from the Maxwell-Boltzmann Law; Modifications Introduced by the Quantum Theory; Maxwell-Boltzmann Distribution Law as Modified by Quantum Theory; Use of the New Form of Maxwell-Boltzmann Distribution Law; Application to Concentrated Systems; The Principle of Dynamical Reversibility; The Principle of Microscopic Reversibility and its Applications. H. H. Ho.

2467. *Equipartition of Energy.* **L. Lecornu.** (Comptes Rendus, 184. pp. 1220–1223, May 23, 1927.)—This mathematical paper contains a discussion of the equipartition principle for the case of planetary motion, and for an electron circulating about a positive nucleus. H. H. Ho.

2468. *Radiative Friction and Quantum Mechanics.* **G. Beck.** (Zeits. f. Physik, 42. 1. pp. 86–88, 1927.)—According to classical electrodynamics an accelerated charge is subject to a resistance due to its loss of energy in electromagnetic waves, or to radiative friction. The author is of the opinion that in the quantum mechanics there is no radiative friction for the elementary processes. He considers N similar linear harmonic oscillators, which at the time $t = 0$ are all at the quantum level n, and assumes with Heisenberg that the probability of a passage from level i to level $i = 1$ is $w_i = \epsilon i$. The distribution of the N oscillators in the different quantum level at any subsequent time t is then investigated, and an expression is found for the probable number N_{n-i} of oscillators which are at the level $n - i$ at this time. The oscillators are distributed over all the levels $i < n$ in such a way that the number in the lower levels increases with the time, and for $t = \infty$ all the oscillators have reached the lowest level. The energy $E(t)$ of the system at time t is shown to be equal to $E_0(1 - \varepsilon^{-\epsilon t})$, where E_0 is the initial energy, and this equation taken for a single oscillator represents its most probable damping; although we have no knowledge of what any single oscillator will do, on the average the result is the same as in the classical theory. H. N. A.

2469. *Spontaneous Quantum Jumps.* **A. Landé.** (Zeits. f. Physik, 42. 11–12. pp. 835–839, 1927.)—Born has recently calculated the probabilities of jumps from one quantum state to another under the influence of a given external field according to wave mechanics, including the effect of irregular light, so as to relate Einstein's probability coefficients B_{mn} to the new mathematical method. A recent paper by Klein [see Abstract 1650 (1927)] assumes, in order to account for spontaneous emission of the combination frequency ν^{mn} when all the particles are in the initial condition m, the existence of a "non-stationary" streaming in addition to the "stationary" Madelung streaming. The author shows that this Klein streaming is caused by a kind of damping field, which must be placed beside any existing external field. The paper is mathematical. In an addendum attention is called to Dirac's recent paper on spontaneous and compelled radiation, in which the numbers of light quanta are treated as p numbers. This leads directly to the idea of the damping field. H. N. A.

2470. *Unidirectional Quanta in Wave Mechanics.* **G. Breit.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 374–380, May, 1927.)—Dirac [see Abstract 2542 (1926)] had discussed the unidirectional nature of quanta from the standpoint of the new mechanics, and the present paper deals with the mechanism of emission along the lines of Schrödinger, the translational motion of the atom as a whole being taken into account. The charge-current density vector is shown to be propagating with the velocity of light in the direction of the emitted quantum. Only unidirectional quanta can then be emitted according to the theory, since the charge-current wave radiates infinitely more intensely if it travels with light velocity than otherwise. It is shown that Gordon's treatment of the Compton effect involves an analogous phenomenon, and it is suggested that Schrödinger's equations, designed for the conservation of energy and momentum, work out better when the translational motion of the atom as a whole is considered. H. H. Ho.

2471. *Two Remarks on the Wave Theory of Mechanics.* **F. D. Murnaghan** and **K. F. Herzfeld.** (Nat. Acad. Sci., Proc. 13. pp. 330–336, May, 1927.)—The first remark discusses the degree of arbitrariness in the wave equation and shows that while the first order, second degree equation giving the characteristics of a second order, first degree equation are definitely determined by this latter equation, the converse is by no means true. The second remark concerns the energy-frequency relation and indicates a method by which it might be deduced. H. H. Ho.

2472. *The Relativisitic Theory of Quanta.* **D. J. Struik** and **N. Wiener.** (Comptes Rendus, 185. pp. 42–44, July 4, 1927.)—The theory of the gravitational and electromagnetic fields and of quanta in the case of a single electron are developed in a general manner by means of tensor analyses. J. S. G. T.

2473. *Generalisation of the Lorentz Transformation.* **G. v. Gleich.** (Zeits. f. Physik, 43. 7. pp. 499–508, 1927.)—Relations between the differentials of length and time, which on integration yield the Lorentz transformation and which are applicable to curvilinear and accelerated motion, are deduced. J. S. G. T.

2474. *The Doppler Effect in de Sitter's Space-Time.* **L. Silberstein.** (Phil. Mag. 3. pp. 1085–1087, May, 1927.)—The author, in reply to Chazy [see Abstract 2924 (1924) and Comptes Rendus, 183. pp. 1093–1095, 1926], shows that the respective formulæ proposed by himself and Chazy are both rigorous and differ in appearance only. J. S. G. T.

2475. *The Space-Time-Groups of Kolkmeijer.* **A. C. Lunn** and **J. K. Senior.** (Phys. Zeits. 28. pp. 448–453, June 15, 1927.)—Kolkmeijer's theory of space-time crystal symmetry, based on a consideration of the motions of the constituent parts of a geometric symmetrical structure, is discussed [see Abstract 28 (1922)]. The total number of crystal types is found to be 180, which is greater by 13 than the number given by Kolkmeijer. Of these types, 12 are excluded by crystallographic considerations. The remaining 168 types furnish 470 groups satisfying crystallographic laws. The sum of the numbers included in the first three groups is 230, which corresponds with the number of groups given by Schönflies. J. S. G. T.

METEOROLOGY AND GEO-PHYSICS.

2476. *Explanation of Complex Halos.* **M. Pinkhof.** (K. Akad. Amsterdam, Proc. 30. 2. pp. 172–183, 1927.)—Since temperature and surface tension can vary little in any one cloud, the author considers it improbable that ice crystals, some of plates with the principal axis vertical and others of rods with the principal axis horizontal, can co-exist in the same cloud. A summary is given of the explanations of Bravais, Soret and Besson regarding the anthelion and parhelia. Besson's views regarding aggregates of rod-shaped crystals are confirmed by Dobrowolski's experiments and photographs. A sketch is given of a complex halo seen by the author on December 23, 1925, which contained (1) the ordinary ring, (2) upper tangent arc to this, (3) parhelia with arcs of Löwitz, (4) large ring, (5) upper tangent arc to (4), and (6) anthelion. This is examined in detail and is considered to support Bravais' theory of lateral tangent arcs. Of the six phenomena (2) and (4) are ascribed to horizontal ice rods and (6) to aggregates of +-shaped crystals. The author concludes that under rare circumstances the hemimorphous ice prisms—which already under ordinary circumstances are able to produce several halo phenomena at the same time—begin to form combinations of 2, 3 and 4. If this is the case, the rare halo phenomena may be added to a halo. These are the upper and lower lateral tangent arcs to the large ring, the paranthelia and the anthelion. R. S. R.

2477. *Temperature Changes and Wind Structure in the Upper Atmosphere.* **C. K. M. Douglas.** (Roy. Meteorolog. Soc., Mem. 1. pp. 95–104, May, 1927.)—A comparison has been made between the temperature changes of the upper air as observed and as calculated on the assumption that the wind velocity is geostrophic. With this assumption the horizontal gradients of temperature in the free air can be deduced from the variation of wind with height at a given time, and the temperature changes due to purely horizontal movement follow. All available observations obtained in the period 1920–1925 were used and also those at Berck, 1918–1919. The correlation between observed and theoretical changes is a little less than 0·5 for 6-hour and 24-hour time-intervals but higher for large temperature changes. Among discrepancies discussed, the most important are irregularities of pilot-balloon observations with regard both to place and time, temperature changes due to horizontal wind components deviating from the geostrophic value, and temperature changes due to vertical movements. Reference is made to the thunderstorms which move up from the south over easterly surface winds, and features connected with these are discussed in this connection. R. S. R.

2478. *Mechanism of Cyclones and Anticyclones.* **T. Kobayasi.** (Phys. Math. Soc. Japan, Proc. 9. 3. pp. 45–62, March, 1927. In English).—The author continues the treatment outlined in an earlier paper [see Abstract 1999 (1927)]. He considers that the "squall" line is ahead in the upper levels of its position in the lower levels. Descending air results and thus this front gains on the centre. The formation of "squall" lines is treated. Warm fronts are considered to be due to the "squall" lines of preceding cyclones: they are not essential for cyclones, but are always in the centripetal current. Expressions are obtained for the ascending current in the cyclone at different distances from the centre, and also its cause is considered. The lowest levels of the cyclone are constantly being filled up by an inward flow caused by friction between the wind and the earth's surface. Thus excess pressure results in the lower levels, and an ascending current is produced. An example is given of the lines of flow and two lines of discontinuity in the wake of an anticyclone. R. S. R.

ASTRO-PHYSICS.

2479. *Solar Energy.* **D. H. Menzel.** (Science, 65. pp. 431–438, May 6, 1927.)—A short review of past and present theories of the origin of solar energy. A. Wh.

2480. *Drawings of the Corona from Photographs at Total Eclipses from* 1896–1922. **F. Dyson.** (Roy. Soc., Phil. Trans. 226. pp. 363–389, May 12, 1927. Roy. Astron. Soc., Mem. 64. Appendix, pp. 363–388, 1927.)

2481. *Possible Local Cloud of Absorbing Matter.* **E. S. King.** (Harvard Coll. Obs., Circ. No. 299 [13 pp.], 1927.)—In two former papers (Harvard Ann. 59. 179, 1912, and 76. 1, 1916) the writer described two researches into the colour indices of stars, which showed that redness increases with increasing distance, and this indicates the presence of an absorbing medium in space. Although this result agreed with the results of Kapteyn and others, it is inconsistent with the fact that stars with negative indices (blue stars) are found at immense distances, up to 20,000 light-years and more. It is possible, however, that a local cloud may envelop our local star-cluster, which would cause the nearer stars to increase in redness with increasing distance, while those beyond would only be slightly and uniformly reddened. The investigation has therefore been taken up again, based on later and more accurate data, and the results all show redness increasing with distance up to about 10 parsecs. Whether this is due to a local cloud or to another cause, the results are presented in detail as a contribution to the study of correlation in stellar characteristics. M. A. E.

2482. *Theory of Outer Layers of Pulsating Star.* **A. S. Eddington.** (Roy. Astron. Soc., M.N. 87. pp. 539–553, May, 1927.)—In his papers of 1918–19, the author left unsolved the relation between the light-curve and the curve of velocity variation, which concerns the outer regions of a pulsating star. In the inner (adiabatic) region, the greatest outward heat-flow is at the time of greatest compression, but observation shows the greatest outflow at the surface at a time of maximum outward velocity, so that there is a lag of one-quarter period when crossing this transition region ϕ below the photosphere (which is negligible in its effect). The inner boundary of the transition region is at about a depth of 1/17 of the star's radius, so that it has less than 1/200,000 of the star's mass above it, and it plays no mechanical part in the pulsation, being constrained to follow the motion of the inner region. He finds the differential equation for the transition region, and that it is soluble, containing the answer required so far as the phase relation of light-curve and velocity-curve is concerned. But the retardation of phase does not mount up to the required quarter period, the effect at first tending right and later wrong. The results obtained will apply to almost any Cepheid nature hypothesis, because the solution is independent of the central behaviour; the author considers the effects of high internal rotational speed, and of a resisting medium, and concludes that there is some important physical circumstance affecting the outside layers, which is unknown or overlooked. In a postscript he criticises adversely J. J. M. Reesinck's investigation of the same problem. A. S. D. M.

LIGHT.

2483. *Lovibond Colour System. I. Spectrophotometric Analysis of the Lovibond Glasses.* **K. S. Gibson** and **F. K. Harris.** (Bureau of Standards, Sci. Papers, No. 547. pp. 1–46, 1927.)—In a preface **I. G. Priest** explains the need for the above analysis owing to the fact that all sets of the glasses are not quite comparable. Adopting the set in use at the Bureau as standard, a spectrophotometric analysis of these was made over the wave-length range 380 to 750 $m\mu$. The glasses tested were the 60-unit glasses from 1·0 to 20·0 for red, yellow and blue, while other glasses and neutral combinations were also included. The results are tabulated and graphs drawn for the light transmitted. These curves satisfy the relation: $-\log T_\lambda = kN + b$, where T_λ is the transmission for a given wave-length, N the Lovibond number of the glass tested and k and b constants. This is the same relation as for wedges and solutions, with N as the absorbing width. Difficulties encountered by users of the Lovibond system and the need for regrading the glasses are dealt with. R. S. R.

2484. *Coloration of Pressed Rock-Salt.* **K. Przibram.** (Akad. Wiss. Wien, Ber. 136. 2a. No. 1–2. pp. 43–56, 1927.)—When gently pressed on one side, rock-salt is coloured yellow by Becquerel rays more rapidly than when not pressed, but the coloration is less stable. If the pressure is great (over 400 kg. per sq. cm.), the salt becomes greenish-yellow to black and is then turned blue by daylight. At pressures of 5000 kg. per sq. cm., the tendency to become coloured, especially blue, diminishes. Moderate heating before the illumination, intensive illumination or weak irradiation results in more violet tones. Heating to about 200° C. annuls the effect of pressure. After irradiation and illumination crystals pressed in certain places show clearly, by the colour differences, the pressed regions which are separated from other parts by rhombic dodecahedron glide-planes. When suddenly pressed, irradiated crystals become brightly illuminated. Pressed parts of crystals show, after irradiation, considerably increased thermo- and radiophotoluminescence, whilst those pressed after irradiation exhibit diminished radiophotoluminescence and an initial weaker but, after strong heating, more marked thermoluminescence. [See Abstracts 958, 959 (1927).] T. H. P.

2485. *Magnetic Double Refraction in Paramagnetic Gases.* **K. S. Krishnan.** (Indian Journ. Phys. 1. pp. 245–254, May, 1927.)—According to the theory of spatial quantisation, the molecular magnetic moments in nitric oxide, equal to one Bohr-magneton each, should all orientate in a magnetic field with their axes either along or against the field. If the moments are rigidly fixed to the molecules, the latter being optically anisotropic, the medium should exhibit a double refraction as a consequence of the orientation. The magnitude of the double refraction to be expected is calculated; but actually no such double refraction could be observed. This negative result is not peculiar to the quantum theory; on the classical theory oxygen ought to present double refraction, but (Schütz) none could be found. Therefore paramagnetic molecules do not orientate, at least as a whole, in a magnetic field. A. D.

2486. *Difference in the Time Lags in the Disappearance of the Electric Double Refraction behind that of the Electric Field in several Liquids.* **J. W. Beams** and **F. Allison.** (Phil. Mag. 3. pp. 1199–1204, May, 1927.) —A method has been developed by means of which the difference in time lags of the disappearance of the electric double refraction after the removal of the electric field in various liquids can be measured with a precision of $0 \cdot 4 \times 10^{-9}$ sec. Of the liquids investigated, carbon bisulphide had the smallest lag, and is therefore probably the best liquid to use in experiments in which the decay of electric double refraction is used to measure small time intervals. [See also Abstract 1337 (1927).] T. M. L.

2487. *Scattering of Light by Liquid Surfaces.* **L. A. Ramdas.** (Indian Journ. Phys. 1. pp. 199–234, May, 1927.)—The scattering of light by the surface of metallic mercury and a large number of transparent liquids had been observed and studied in detail [see Abstract 2344 (1926)]. These results are now compared with the theory proposed by R. Gans [for mercury, Abstract 2028 (1924); for transparent liquids, Abstract 1563 (1926)]. In the case of mercury, most of the intricate polarisation and intensity-distribution effects, when the incident light is polarised, are indicated by the theory; but when the incident light is unpolarised, whereas observation shows a more or less uniform distribution of the intensity, the value calculated from the theory shows too rapid an increase in the intensity of the scattered light as the reflected beam is approached. For transparent liquids the theory shows the main features of the scattered light. Near the critical temperature Gans' theory agrees best when the roughness is at its maximum. A. D.

2488. *A New Spectrograph.* **W. Ewald.** (Zeits. Instrumentenk. 47. pp. 257–261, May, 1927.)—Description of the Askania Universal spectrograph, capable by change of objectives and prisms of being adapted to spectral regions of 210–500, 320–600 and 400–800 $\mu\mu$ respectively. Photographic adjuncts are included. A. D.

2489. *Copper Tartrates.* **P. Gabiano.** (Comptes Rendus, 184. pp. 1059–1062, May 2, 1927.)—These experiments were conducted for the purpose of isolating definite compounds of copper and tartaric acid, to which ought to be attributed the circular dichroism discovered by Cotton. The optical studies of these, up to the present, have been carried out only on mixtures of very badly-defined nature; the composition and optical properties of the bodies in question are still unknown. Tartrate of copper and ammoniacal and soda salts as instances of alkaline copper tartrates are here dealt with. It is concluded that the three alkaline copper compounds possess circular dichroism; this phenomenon being most marked in the case of $(C_4O_6H_4)CuNa_2$. It appears that a relationship exists between the magnitude of the specific rotatory power and that of the dichroism. A. E. G.

2490. *Rotatory Power of the Tartaric Ion.* **E. Darmois.** (Comptes Rendus, 184. pp. 1239–1241, May 23, 1927.)—Although the tartaric ion in the neutral tartrates has an almost constant rotatory power in water, this is no longer the case in presence of neutral salts such as calcium chloride, lanthanum nitrate and chloride, and aluminium chloride, all of which give rise to negative rotations, whilst thorium nitrate gives very large positive rotations. T. M. L.

2491. *Rotatory Power of Tartaric Acid in Aqueous Calcium Chloride.* **E. Darmois.** (Comptes Rendus, 184. pp. 1438–1440, June 13, 1927.)—The specific rotatory power of tartaric acid in solutions containing a constant concentration (*e.g.*, 1·8M) of calcium chloride increases (*i.e.*, becomes less negative) as the dilution increases, but the dispersion is too small to be expressed by the two compounds recognised hitherto. The electrometric measurements with a hydrogen electrode give values for the activities of the hydrogen ions which are much greater than their maximum possible concentrations. An alternative estimate of the real concentrations of the hydrogen ions can be made by measuring the concentrations of hydrochloric and tartaric acids required to give equal *p*H values in presence of the given proportion of calcium chloride. The ratio of these two acid-concentrations varies in a parallel manner with the specific rotatory power of the tartaric solution. T. M. L.

2492. *Calculation of the Rotatory Power of a System of Anisotropic Molecules or Atoms. Application to Quartz.* **R. de Mallemann.** (Comptes Rendus, 184. pp. 1241–1243, May 23, 1927.)—A formula is deduced in which the rotatory power is proportional to the square of the birefringence. This gives a rotatory power of the right order of magnitude in the case of quartz, and provides an explanation of the high rotatory power of cinnabar where the birefringence is also exceptionally great. **Errata** (*ibid.*, p. 1380, June 7, 1927). T. M. L.

2493. *Selective Absorption and Anomalous Natural and Magnetic Rotation of Camphor Chinone Solutions in Toluol.* **A. Krethlow.** (Zeits. f. Physik, 42. 11–12. pp. 840–852, 1927.)—The absorption has been measured with six different concentrations, in the spectral region 632 to 440 $m\mu$, for 33 wave-lengths, using the König-Martens spectral photometer, and the extinction coefficients have been calculated. The Beer-Lambert law was confirmed within 8 %. The absorption curve is of compound nature, and is due to four single bands, the maxima of which coincide with the extreme values, maxima or minima, of the small anomalies of the magnetic and the natural rotation of the plane of polarisation of light in this substance: this is the Voigt type of relation. The resultant absorption is related to the main anomaly in accordance with the Drude type, *i.e.*, the maximum of the resultant absorption curve is shifted, in this case towards the red, when compared with that of the rotation. H. N. A.

2494. *Analysis of a Rectilinear Vibration of Ultra-Violet Light.* **G. Bruhat** and **M. Pauthenier.** (Rev. d'Optique, 6. pp. 163–184, April, 1927.)—Light from a mercury arc passes through a special form of double spectroscope to get the maximum purity in the radiation. All optical parts are of quartz or fluorspar. A parallel beam of light traverses an analyser and a polariser with the substances to be tested placed between them. Finally the light is focussed on a photographic plate. Special precautions are taken to eliminate stray radiations. A series of records is obtained on the photographic plate for successive positions of the analyser equally spaced on either side of the central position. The results are examined with a Fabry-Buisson microphotometer, and the direction of vibration of the light tested is found with great accuracy. By an electrical arrangement the successive exposures are made automatically. Many possible sources of error are examined and the means employed to eliminate them explained. An accuracy up to a few seconds in angle is possible. Where the polarimeter vessel is closed at its ends by quartz plates of the same thickness, it is necessary to pay special attention to parallelism, good optical definition of the surfaces and the mean ray perpendicular to the surfaces. It is best to work at a little below the normal exposure of the photographic plate, towards the region of under-exposure. R. S. R.

2495. *Scattering of Light in Water-Clouds.* **G. I. Pokrowski.** (Zeits. f. Physik, 43. 5–6. pp. 394–403, 1927.)—Experimental work on the intensity and polarisation, with water-droplets from $0\cdot4$ to $0\cdot7\ \mu$ diameter. The results are in qualitative and partly in quantitative harmony with the Rayleigh-Mie theory. A. D.

2496. *Quantum Theory of Dispersion.* **P. A. M. Dirac.** (Roy. Soc., Proc. 114. pp. 710–728, May 2, 1927.)—A mathematical paper not permitting of a concise abstract. A. B. W.

2497. *Ratio of the Numbers of Resonating Electrons for the Potassium Doublet.* **V. K. Prokofiev.** (Phil. Mag. 3. pp. 1010–1025, May, 1927.)—Sellmeier's formula for dispersion in regions remote from the absorption lines is $n^2 - 1 = \Sigma a_i\lambda^3/(\lambda^2 - \lambda_i^2)$, in which λ_i denotes the wave-length corresponding to free vibrations of the electron, and a_i is given by $\rho_i\lambda_i^2/8\pi^2c^2$ where $\rho_i = 4\pi N_i e^2/m$, N_i being the number of absorbing electrons per c.c. It is thus possible to calculate N from dispersion measurements. For the D-lines, Ladenburg and Minkowski [see Abstract 1160 (1922)] determined N_1 and N_2 corresponding to the two lines, and found that their sum is equal to the number of sodium atoms per c.c. Either there are two sets of sodium atoms, each set corresponding to a line, or all the atoms are alike, but the electrons can vibrate in two different ways. In this case N_1/N_2 is an atomic constant. Analysis of previous results shows this number to be two (approximately) in the case of sodium. The present paper describes similar experiments with potassium. Actually the value $(N_1 + N_2)_A/(N_1 + N_2)_B = \sigma$ was determined at different pressures and temperatures. It is concluded that σ is independent of vapour density. G. E. B.

2498. *Absorption of Radiation in the Extreme Ultra-Violet by the Inert Gases.* **C. Cuthbertson.** (Roy. Soc., Proc. 114. pp. 650–658, May 2, 1927.)—Using Drude's form of the dispersion equation values of q, the number of "dispersion" electrons per molecule and of n_0, the free frequencies λ_0 are calculated for the five inert gases. A vacuum spectrograph was employed to study the absorption in the extreme ultra-violet, where the calculated values of λ_0 occur. A carbon arc *in vacuo* was used as the source of radiation, as a continuous spectrum could not be obtained; the position of the absorption band in each gas was sought by observing, at different pressures, which of the bright lines were blocked out by it. For xenon the point of maximum absorption appears to lie between λ687 and λ903·7, probably not far from λ858; calculated free frequency corresponds to $\lambda_0$1001. In krypton the absorption begins near λ904, and probably culminates on the long wave-length side of λ687, calculated $\lambda_0$840. In argon (λ_0 at 726) absorption begins between λ858 and the group λλ809, 806, 799; the maximum cannot be located. Helium ($\lambda_0$507) absorption begins about λ858, and seems to increase more slowly than for the heavier gases. Neon ($\lambda_0$481); the lines in the extreme ultra-violet were almost as strong as in a vacuum. H. N. A.

2499. *Relation between the Refractive and Dispersive Constants of the Inert Gases.* **C. Cuthbertson.** (Roy. Soc., Proc. 114. pp. 659–661, May 2, 1927.)—Refers to a previous paper on some constants of the inert gases [see Abstract 581 (1911)], and to a simultaneously published paper on the absorption of these gases [see preceding Abstract]. If the evidence here obtained is accepted, it appears that the values of q represent in some way the average or effective number of dispersion electrons in the atom. If the cube roots of the refractivities of these gases for long waves are plotted against q^2, the points lie with considerable accuracy on a straight line. From this it is deduced that according to the old Clausius-Mosotti hypothesis the radius of the atom is proportional to q^2 plus a constant; a similar result is obtained from the modern theory of electronic structure. H. N. A.

2500. *Influence of Temperature on Photographic Impressions.* **G. Colange.** (Comptes Rendus, 184. pp. 1167–1169, May 16, 1927.)—Researches having for their object the study of the optical properties of the high atmosphere have made it necessary to take into consideration the influence of cold upon photographic plates at the time of exposure. In the experiments here described, exposures at low temperatures are made with maximum lighting E_0, and densities D_1, D_2. . . . corresponding to $\log E_1$, $\log E_2$, . . . less than $\log E_0$ are obtained. The cold, therefore, plays the same rôle as a diaphragm or absorbent screen placed between the source and the plate. Further, it is found that the curve connecting the temperatures t_1, t_2, . . . with $\log E_1$, $\log E_2$, . . . is practically a straight line. Suppose E_0 to be the lighting produced by a given source upon a plate at t_0, if the temperature be lowered to $t°$ and an exposure made with the same lighting E_0 for the same length of time, the density measured upon the plate will correspond to a new lighting E, such that $E = E_0 . 10^{-a(t_0 - t)}$. In these experiments a varies between 0·007 and 0·03, and it is proposed to study its variations as a function of conditions of photographic impression. A. E. G.

2501. *New Type of Photographic Exposure Meter and Photometer.* **F. H. Norton.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 435–444, May, 1927.)—The development of a small and inexpensive photometer for determining light intensities and photographic exposures is described. A study is made of the performance of two types of instrument. In a large number of readings by a single observer with the smaller type it was found that the average error in measuring exposures on neutral coloured objects was 22 %, which corresponds to about 7 % difference in the density of the photographic image. The larger type had a precision of better than 5 % for most of the range. AUTHOR.

2502. *Chemiluminescence of Phosphorus Vapour.* **E. J. Bowen** and **E. G. Pells.** (Chem. Soc., J. pp. 1096–1099, May. 1927.)—The number of molecules producing light during the phosphorescence of phosphorus is determined by measuring photographically the number of quanta of light emitted. Equality of blackening between one part of a panchromatic plate exposed to the glow and another part to the light from a tungsten filament lamp passed through a copper-sulphate-ferrous sulphate filter to eliminate infra-red radiation is taken to indicate equality of luminous energy in the two cases. This assumption supposes the similarity of the distribution of energy in the visible region of the spectrum of glowing phosphorus vapour and of the filtered light from the tungsten lamp. Such supposition is found to be sufficiently justified. The final product of the oxidation is phosphoric oxide, resulting from a number of consecutive reactions, of which only one, involving one molecule of oxygen, probably emits light. This being so, one-fifth of the oxygen molecules reacting may be taken as the number concerned in the luminescent stage. For the ratio of this number of molecules to the number of light quanta emitted, values varying from $3\cdot4 \times 10^3$ to $1\cdot7 \times 10^4$ are obtained. Another series of experiments arranged to eliminate possible error due to reaction of some of the oxygen with the solid phosphorus present gives values ranging from $1\cdot81$ to $2\cdot52 \times 10^3$. As the light emitted is partly obscured by the cloud of solid oxide formed, the proportion of luminescent molecules is probably greater than is indicated by the above figures. Moreover, the number of molecules emitting ultra-violet light is not given by the experiments. T. H. P.

2503. *Fluorescence and Phosphorescence.* **E. Gaviola** and **P. Pringsheim.** (Zeits. f. Physik, 43. 5–6. pp. 384–393, 1927.)—The duration of luminescence of various phosphors was investigated with a rotating phosphoroscope and a Gaviola fluorometer. All bands of dyestuff phosphors gave a very rapidly-extinguished fluorescence followed by a relatively weak and lingering phosphorescence. Uranium glass and ruby, on the other hand, gave only a gradually waning phosphorescence. There exists no continuous transition from fluorescence to phosphorescence. A. D.

2504. *Fluorometer.* **E. Gaviola.** (Zeits. f. Physik, 42. 11–12. pp. 853–861, 1927.)—Describes an apparatus by which persistence (Abklingungszeiten) of fluorescence of the order 10^{-9} sec. may be measured within 10 %. The method was applied to solutions of dyestuffs in water, glycerine and methyl-alcohol, and the results were all less than 5.10^{-9} sec. W. H. Ge.

2505. *Temperature and Concentration in Fluorescence.* **E. Gaviola.** (Zeits. f. Physik, 82. 11–12. pp. 862–869, 1927.)—By the help of the apparatus described in the earlier paper [see preceding Abstract] a study was made of the influence of temperature and concentration on the persistence of fluorescence in solutions of dyes. For rhodamin B in glycerine change of concentration from $48\cdot3\,.\,10^{-3}$ to $0\cdot019\,.\,10^{-3}$ gm./cm.^{3} increased the persistence from $1\cdot1 \pm 0\cdot4\,.\,10^{-9}$ to $4\cdot3\,.\,10^{-9}$ sec. At concentration of about $2\,.\,10^{-3}$ gm./cm.^{3}, increase of temperature (20–170° C.) decreased the persistence of fluorescence of solution of rhodamin B or rhodulin orange in glycerine to about one-quarter of the value at 20° C. W. H. Ge.

2506. *New Light Source for Resonance Spectra.* **G. Cario and W. Lochte-Holtgreven.** (Zeits. f. Physik, 42. 1. pp. 22–25, 1927.)—A new source is described for exciting resonance fluorescence; it possesses great brightness, long life and constancy in working. It is described here working with sodium and thallium vapours; but the same principle can be applied to any metallic vapour. An iron anode is placed in a side tube, end-on observation is used through a quartz window, and the metal is used as a kathode. The whole tube is made out of pyrex glass, and argon circulates through it while in use. A. C. M.

2507. *Secondary Radiation and Polarisation of Resonance Radiation in Cadmium.* **W. A. MacNair.** (Phys. Rev. 29. pp. 677–682, May, 1927.)—Attention is called to the points of difference between the conditions under which the two types of optically excited spectra of mercury vapour appear, namely, resonance radiation and fluorescence. In the present experiments it is noted that when a bulb containing cadmium with a slight impurity of mercury is illuminated by light of 2288 Å. wavelength the secondary radiation contains the mercury line 2536·7 Å. in addition to the cadmium lines 2288 Å. and 3261 Å. provided the metal is distilling. As soon as the vapour is stagnant, however, only the cadmium 2288 Å. line appears. The suggestion is made that the phenomenon is due to the presence in the distilling vapour of unstable HgCd molecules. In such a molecule the Cd atom may absorb the 2288 Å. radiation, and subsequently in the breakdown of the molecule may excite the Hg atom by a collision of the second kind. The polarisation of the cadmium resonance radiation (3261 Å.) in zero magnetic field under certain conditions was found to be 35 %. In order to explain this value by the kinetic theory, one must assign effective radii to the colliding atoms which are thirty times the radii effective in ordinary collisions. AUTHOR.

2508. *Proposed Experiment on Resonance Radiation and Derivation of the Formula for the Doppler Shift of Scattered or of Resonance Radiation.* **A. E. Ruark.** (Phil. Mag. 3. pp. 1051–1056, May, 1927.)—When light of wave-length 2536 Å. from a mercury resonance lamp is allowed to fall on a bulb containing mercury vapour heated above 275° C., the effects observed depend to a marked degree on the density of the mercury vapour [see Abstract 503 (1923)]. It is suggested that our knowledge of resonance and scattering will be increased by studying the space distribution of the light sent out by the mercury vapour. Different vapour pressures should be used and the incident beam polarised in various planes, as well as unpolarised. Further, the polarisation of the emitted light should be studied in the neighbourhood of the regularly reflected beam. In the second part of this paper Schrödinger's formula for the Doppler shift of the radiation from a moving atom is extended to obtain a formula for the shift in scattered radiation. A. W.

2509. *Diffusion of Imprisoned Resonance Radiation in Mercury Vapour.* **M. W. Zemansky.** (Phys. Rev. 29. pp. 513–523, April, 1927.)—The imprisonment of resonance radiation in mercury vapour was studied by measuring the rate at which resonance radiation emerged from one face of a slab of vapour after the exciting light, incident upon the other face, was cut off. The radiation fell off exponentially, and the exponential constant of decay was measured for vapour densities ranging from $0 \cdot 77 \times 10^{15}$ atoms per c.c. to 29×10^{15} atoms per c.c., corresponding to temperatures ranging from 60° C. to 130° C. Slabs of two different thicknesses were studied, one 1·95 cm. and the other 1·30 cm. For vapour densities lower than about 4×10^{15} atoms per c.c. the exponential constant varied approximately inversely as the square of the thickness of the slab, in qualitative agreement with the theory of the diffusion of imprisoned radiation as worked out by Milne. In this region of vapour densities the exponential constant also decreased with the vapour density. The failure of Milne's results to give quantitative agreement with this result is discussed, and it is suggested that this discrepancy is due to the fact that the exciting light in this experiment was a very broad spectral line, and that postulated by Milne of very narrow width. A rough method of extending Milne's theory to include the absorption and imprisonment of frequencies larger and smaller than the heart of the 2536·7 line is discussed, and it is shown that the experimental results can be explained on this basis. At higher vapour densities, the decay constant increased almost linearly with the number of absorbing atoms per c.c. It is shown that this result is in accordance with the theory of imprisonment when extended to include impacts of the second kind. The probability of an impact of the second kind between a normal and an excited mercury atom is calculated from the experimental data and found to be approximately 9×10^{-4}. AUTHOR.

2510. *Studies on the Mercury Band Spectrum of Long Duration.* **(Lord) Rayleigh.** (Roy. Soc., Proc. 114. pp. 620–642, May 2, 1927.)—A stream of mercury vapour was excited by a current of less than a milliampere, using a hot kathode, and the spectrum was observed outside the region of discharge. The resonance line 2537 is associated with the band spectrum, but the resonance line 1850 is absent. The "forbidden" lines 2270 $I^1S_0 - I^3P_2$ and 2656 $I^1S_0 - I^3P_0$ were both observed; the second of these has not been found before, it is much stronger than the 2270 line, but much weaker than 2537 $I^1S_0 - I^3P_1$. These forbidden lines are also associated with the band spectrum. The band spectrum decays at the same rate throughout after excitation, reaching half-value in $1 \cdot 80 \times 10^{-3}$ seconds. If the stream of vapour is passed through a heated tube the broad visual maximum is extinguished, that at 2345 with its attendant bands and the fainter maximum at 2650 are slightly weakened, while the resonance line 2537 with the bands near it and the broad maximum at 3300 are almost unaffected. H. N. A.

2511. *Supposed Abnormal Series of Mercury Atoms.* **R. G. Loyarte and A. T. Williams.** (Phys. Zeits. 28. pp. 383–387, May 15, 1927.)—Loyarte has previously shown [see Abstract 766 (1927)], in a paper on the excitation potentials of mercury atoms, that the potentials obtained by Franck and Einsporn, and by Loyarte, can be calculated within the limit of error if the potential 1·4, or some multiple of it, is added to the potentials corresponding to the optical lines or terms of the known series. It is now concluded, from the existence of this addition-potential, that there are abnormal series. The mercury vapour excited by electron shocks is spectroscopically examined. Lines appear on the spectrogram which are probably first lines of two of the mercury abnormal series. A. E. G.

2512. *Fading of the Band Spectrum of Mercury Vapour.* **Marie Asterblum.** (Zeits. f. Physik, 43. 5-6. pp. 427-430, 1927.)—Houtermans has recently investigated the fluorescence of the unresolved bands, which are to be regarded as intensity maxima of the continuous spectrum of Hg vapour. He found the relative rate of fading was greater for $\lambda = 4850$ Å. than for $\lambda = 3300$ Å., and a similar difference between the bands at 2537 Å. and 2650 Å. [see Abstract 2067 (1927)]. The author has repeated the observations on the first two of the above bands, measuring the spectrograms with a microphotometer. She finds that the rate of fading of the two maxima is the same, the fading taking place exponentially. H. N. A.

2513. *A Possible Explanation of the Zeeman Effect of Type D_1 and D_2.* **F. J. v. Wiśniewski.** (Zeits. f. Physik, 42. 11-12. pp. 910-914, May, 1927.)—The equations of motion of an electron attracted to a centre (ion) in a constant magnetic field have two different solutions [see Abstract 1900 (1927)]. From this a theory of the Zeeman effect of the D_1 and D_2 type for small magnetic fields is built which rests solely on the laws of mechanics, electricity and the quantum theory. G. E. A.

2514. *Doppler Effects and Intensities of Lines in the Molecular Spectrum of Hydrogen Positive Rays.* **M. C. Johnson.** (Roy. Soc., Proc. 114. pp. 697-710, May 2, 1927.)—Definite groups of lines in the secondary spectrum of hydrogen are known to be strengthened in certain types of discharge, and the interpretation of these phenomena in terms of specific molecular excitations has been begun by Richardson on the basis of his classification of associated groups into bands. In the present paper the grouping of lines in the secondary spectrum is studied by longitudinal observation of positive rays in hydrogen. Further, Doppler components have been found and evidence thus obtained as to which of the lines in the secondary spectrum are mainly due to the excitation of stationary molecules and which are carried by neutralised positive rays. With five exceptions, the secondary spectrum is due to stationary diatomic molecules which have not been recently ionised. The Balmer spectrum is partly due to excitation of free atoms and partly due to neutralisation of positively charged atoms which were already dissociated when in the dark space. The ratio of the former to the latter increases along the Balmer series, and with the increase is associated a decrease of the Fulcher characteristics in the secondary spectrum. H. H. Ho.

2515. *Series Spectra of Silver-like Atoms.* **R. J. Lang.** (Nat. Acad. Sci., Proc. 13. pp. 341-346, May, 1927.)—The series spectra of the stripped atoms homologous with silver were investigated by Carroll, who identified the first members of the principal, diffuse and fundamental series of InIII and the first principal pair of SnIV. It has now been possible to complete the identification of the first members of each of the four ordinary series for InIII and SnIV and to determine these also for SbV. The investigation is carried out by means of a vacuum spectrograph employing a grating of 2 metres radius and 30,000 lines per inch. The high-potential spark *in vacuo* is used as source. The standards of wavelength employed are those obtained by Smith and the author. The plates obtained are of excellent definition for indium and tin; those of antimony, while not so strong, are of fair definition. A. E. G.

2516. *The Spectrum of CO_2.* **G. W. Fox, O. S. Duffendack** and **E. F. Barker.** (Nat. Acad. Sci., Proc. 13. pp. 302–307, May, 1927.)—The continuous flow method previously employed by the authors for HCl [Abstract 2381 (1926)] was used for carbon dioxide in the present case. The present work was undertaken to decide whether any of the bands observed in the carbon monoxide spectrum were due to the carbon dioxide molecule. The resulting spectrum consists of bands of several different types and extends from 5000 to 2800 Å. In general, the bands are degraded towards the red and have sharp edges. The bands with edges near 2880 and 2895 Å. are distinctly different from the others in structure. The two intensity maxima in this region were resolved by a larger spectrograph into double-edged bands. Each band of these has two oppositely degraded branches with sharp inner edges, between which a narrow band appears, resembling somewhat the ammonia bands at 3360 and 3370 Å., except that the narrow inner band is included. No relation between the bands and those constituting the groups has been discovered. The spectrum of CO_2 obtained was measured up, and the results are tabulated. A higher dispersion is necessary for conclusive work to be done. S. G. B.

2517. *Line Absorption Spectra of the Alkaline Earth Elements.* **O. H. Walters** and **S. Barratt.** (Phil. Mag. 3. pp. 991–993, May, 1927.)—The absorption spectra of the vapours of the alkaline earth elements show the possibility of transitions of the series electron from its normal 1S orbits to orbits of the P, p_2, D and F types [see Abstract 584 (1919)]. The transition to a D orbit has been observed in calcium and strontium vapours and to an F orbit in barium vapour. The selection rule of unit change in the azimuthal quantum number evidently does not hold, and changes of 2 and 3 occur in absence of any applied field. The series $1S - mP$ is the most readily absorbed, and many members of such series can easily be photographed. The widths of these lines are very sensitive to the partial pressure of the metal vapours; this tendency to broaden would be expected from the analogy with the behaviour of the corresponding series of the alkali metals. The $1S - mP_2$ lines are always much fainter, only the first member being observed. The $1S - mD$ lines are even more weakly absorbed and are difficult to observe. The first three members of the $1S - mF$ series of barium are quite strongly in evidence, though the corresponding lines of the other elements are absent. T. H. P.

2518. *Absorption Spectra and Pleochroism of Iodine and of Herapathite.* **P. Bovis.** (Comptes Rendus, 184. pp. 1237–1239, May 23, 1927.)—Solid iodine has a strong absorption band at 2550 Å.U. The densities of a film 1 micron thick are 0·35 at 6800 Å.U., rising to 6·14 at 2576 Å.U. and falling again to 3·72 at 2302 Å.U. Data are also given for thin films of "herapathite," a product obtained by crystallisation from acetic acid of a mixture of quinine bisulphate and tincture of iodine; this product gives an almost constant density from 6400 to 5400 Å.U. Both products showed marked pleochroism when the densities were determined for polarised light. T. M. L.

2519. *Absorption Spectra of Ga, In, Mn, Cr, Ni and Co in Under-Water Sparks.* **A. W. Smith** and **M. Muskat.** (Phys. Rev. 29. pp. 663–672, May, 1927.)—The absorption of gallium, indium, manganese, chromium, nickel and cobalt has been studied in under-water spark spectra. Many new lines, not previously found in absorption spectra, have been located. The results confirm and extend the observations on the absorption of these elements in the vapour state. For indium and gallium they confirm the conclusion that the normal state of the atom is the $2p$ state, and for manganese the conclusion that the ground-level of the valence electron is the $1s$ septet level. For chromium, nickel and cobalt they afford a verification of the assignment of lines and arrangement of terms with respect to the ground-level as given by Catalán and Gieseler for chromium, by Bechert and Sommer for nickel, and by Catalán and Bechert for cobalt. AUTHORS.

2520. *Excitation of the Spectrum of Indium.* **J. G. Frayne and G. W. Jarvis.** (Phys. Rev. 29. pp. 673–676, May, 1927.)—The indium metal was vaporised at a temperature of 650° C. in an iron cylindrical anode within a quartz tube. Electrons from an oxide-coated Pt filament passed through a helical grid into a force-free space, where they collided with the atoms of indium vapour. The spectrum was viewed end-on through a transparent quartz window. At 3·3 volts the lines $2p_1 - 2s$ and $2p_2 - 2s$ appeared. At 4·2 volts the additional lines $2p_1 - 3d$ and $2p_2 - 3d$ appeared. At 7 volts higher members of the series and several unclassified lines were present on the plates. At 13·2 volts the spectrum became very strong and the line 2306 Å. appeared in addition to the recognised series lines. It is possible that the second arc spectrum was excited at this potential. The resonance lines were found to be less intense than the corresponding lines due to the metastable atoms.

AUTHORS.

2521. *Note on a Connection between the Visible and Ultra-Violet Bands of Hydrogen.* **O. W. Richardson.** (Roy. Soc., Proc. 114. pp. 643–650, May 2, 1927.)—Considers the Werner and the Lyman bands [see Abstract 1022 (1927)] and the experimental and theoretical work of Diecke and Hopfield, who have shown that the final electronic state A is the same for both the above sets of bands, but that the initial states, B for the Lyman bands and C for the Werner, are different. Diecke and Hopfield have calculated the values of w_0, which measures the vibration frequency at infinitesimal amplitude, and xw_0, which determines the deviation from simple harmonic motion for these states. The author concludes that A has a total quantum number one, and that it is probable that B and C have the total quantum number two. There is no discovered state in the visible which corresponds to the B state, but both the author's 2σ and 2π states appear from these results to be very close to the C state. New calculations have been made of w_0 and xw_0, and these results appear to rule out the 2σ state, but show agreement between the C state and the 2π state. The author finds evidence of final 2π states in the spectrum, and calculates the moment of inertia of the H molecule with more certainty than previously: $J_0 = 7{\cdot}81 \times 10^{-41}$, $r_0 = 1{\cdot}005 \times 10^{-8}$ cm. in the 2π state; r_0 is the distance between the nuclei. The paper concludes with some remarks on the heat of dissociation. H. N. A.

2522. *Duration of Luminosity of the Ultra-Violet Series of Hydrogen.* **W. Wien.** (Ann. d. Physik, 83. 1. pp. 1–18, May 23, 1927.)—The source of light is a pencil of positive rays issuing from a slit and exciting the

Lyman series inside a vacuum grating spectrograph. Five members of the series were photographed with a specially ruled grating and Schumann plates. The current carried by the positive rays to a metal plate was used as a measure of intensity of the rays and the intensity of the spectra determined from the blackening of the plate. The first two members of the series, H_a and H_b, have the same decay constant. F. S.

2523. *Behaviour of Schumann Plates in the Vacuum Spectrograph.* **W. Wien.** (Ann. d. Physik, 83. 1. pp. 19–22, May 23, 1927.)—Complete blackening of the plate was observed in experiments on the production of the Lyman series by positive rays [see preceding Abstract]. Experiments undertaken to discover the cause of this action on the plate failed to trace it to any form of radiation, and it is tentatively taken to be due to the chemical action of atomic hydrogen and oxygen. F. S.

2524. *Discharge in Hydrogen as a Source of Continuous Spectrum in the Ultra-Violet.* **M. Lambrey** and **D. Chalonge.** (Comptes Rendus, 184. pp. 1057–1059, May 2, 1927.)—Previous attempts to use the discharge in hydrogen as a source of continuous spectrum in the ultra-violet have not proved very successful, owing partly to the difficulties met with in the method employed, partly to the weak intensity obtained. A method is here described by which it is claimed that the hydrogen tube functions perfectly regularly and the spectrum emitted is intense. This method is compared with the following other means used for the ultra-violet: Positive crater of the carbon arc; incandescent lamp with metal filament and quartz window; sparks condensed under water. A. E. G.

2525. *Structure of the Ultra-Violet Absorption Band of Ozone.* **D. Chalonge** and **M. Lambrey.** (Comptes Rendus, 184. pp. 1165–1167, May 16, 1927.)—The ultra-violet absorption spectrum of ozone is composed essentially of a large band extending from 3450 to 2300 Å., the general form of which has been studied quantitatively by Fabry and Buisson. Upon the slope of this band, between 3450 and 3050 Å., are the fine bands, known as bands of Huggins, which have been studied by several observers. Recently Shaver has shown that the maximum region is equally resolved into fine bands. The present authors have been able to establish that the Shaver system of bands, on the one hand, are prolonged on the side of short wave-lengths, and, on the other, are reconciled with those of Huggins; and also to establish the complete structure of the large ultra-violet band. On the contrary to those already known, the bands now measured are very difficult to observe. Their examination has only been possible by using the continuous spectrum of hydrogen. [See also preceding Abstract.] A. E. G.

2526. *Electronic Arrangements Corresponding to the 3rd Order Emission Spectrum of Oxygen.* **C. Mihul.** (Comptes Rendus, 184. pp. 1055–1057, May 2, 1927.)—The author has shown in a previous paper [see Abstract 2045 (1927)] that most of the rays in the 3rd order spectrum of oxygen (O.III) form multiplets of which some are of a system of triplets ($r = 3$), whilst others are of a system of quintriplets ($r = 5$). In the present note the author indicates the possible electronic configurations corresponding to these two systems. The original paper should be consulted in regard to the tabular matter. A. B. W.

2527. *The Spectrum of Ionised Nitrogen.* **A. Fowler** and **L. J. Freeman.** (Roy. Soc., Proc. 114. pp. 662–689, May 2, 1927.)—The spectrum has been investigated by means of condensed discharges in vacuum tubes; most of the nitrogen molecules break down to ionised atoms, and with moderate discharges the NII spectrum appears almost alone, and has been recorded from λ6850 to λ830, the limit of action of the vacuum spectrograph. In the analysis of the spectrum the recent developments of the theory due to Pauli, Heisenberg and Hund have been employed. The majority of the brighter lines, and many of the fainter ones, have been classified, the majority being due to transitions of a single electron. According to the new theory the structure of the spectrum represents the resultant effect of all the electrons which form parts of uncompleted shells; a given configuration of electrons gives rise to a group of terms the energy values of which differ a little owing to the different orientations of the orbits. In the case of NII the two electrons concerned in the production of the spectrum are normally in 2_2 orbits, and the corresponding theoretical terms are I^3P, I^1D_2' and I^1S_0'; when one of the electrons is in a 3_1 orbit the terms are I^3P' and I^1P_1', with other terms when the electron is in the orbits 3_2, 3_3, 4_1, 4_2, 4_4, 4_5 or 5_1. The triplet combinations are worked out by means of the recurrence of separations; there is more difficulty with the singlet terms. There are in addition some lines which seem to be due to simultaneous jumps by two electrons. H. N. A.

2528. *Structure of the Nitrogen Spectrum of the Second Order.* **F. Croze** and **J. Gilles.** (Comptes Rendus, 184. pp. 1053–1055, May 2, 1927.)—In conformity with the law of alternation of multiplicities the nitrogen spectrum of the second order (NII) is formed by combinations between the terms of odd multiplicity. A certain number of these terms which had been discovered independently by Croze [see Abstracts 1092 and 1093 (1925)] and by Fowler have been mentioned by Hund with different electronic configuration of the ion (NIII) and with different orbits described by the emissive electron: a group of terms ^3P and ^1P with the configuration $(ssp)np$ with $n \geq 3$; a group of terms ^3S . ^3P . ^5D with the configuration $(ssp)np$ with $n \geq 3$. The theory of Hund allows equally to foresee the existence of groups of terms ^3P . ^3D . ^3F corresponding to the configuration $(ssp)nd$. This is in effect what really takes place. The terms ^3D and ^3F are those which enter into combination to give the multiplet DF, already discovered by one of the present authors; the terms ^3P are determined by the combinations forming multiplets given here in detail. A. E. G.

2529. *Electronic States and Band Spectrum Structure in Diatomic Molecules. Part IV. Hund's Theory; Second Positive Nitrogen and Swan Bands; Alternating Intensities.* **R. S. Mulliken.** (Phys. Rev. 29. pp. 637–649, May, 1927.)—After a brief review of Hund's theory of molecular electronic states and band spectra [see Abstract 2013 (1926)], and a discussion of intensity relations and selection principles in terms of the correspondence principle, it is shown that practically all the available evidence, as embodied in previous papers of this series and elsewhere, is in agreement with the theory. The occurrence of ρ-type S terms and σ-type P and D terms is explained by the theory, as also the existence of ρ-type and σ-type doubling. Selection rules and other relations in $^2P \rightarrow {}^2S$ and $^2S \rightarrow {}^2P$ transitions (including, in agreement with Mecke and Hulthén, the CH, OH, MgH and CaH bands) are discussed. Hund's interpretation of the second positive nitrogen bands as a $^3P \rightarrow {}^3P$ transition is further developed, and extended to the Swan bands; the apparent absence of Q branches, and other intensity relations in these bands, are explained; the rotational doubling in these bands (accompanied by alternating intensities) is interpreted as σ-type doubling. It is shown that the alternating intensities or alternate missing lines in the He_2, N_2, Swan and N_2^+ bands can all be accounted for formally by the postulate that they are due to alternate (partially or completely) suppressed levels such that the suppressed values of $(j_k - \sigma_k)$ are always as follows: B rotational sub-states $(j - \frac{1}{2} - \sigma_k) = 0, 2, 4, \ldots$; A sub-states, 1, 3, 5, . . . ; here σ_k is the part of σ which is due to the orbital angular momentum of the electron, and j_k is the resultant of σ_k and the quantity m which measures the nuclear angular momentum in quantum units. Finally, the questions of term notation and formulation, j values for odd and even molecules, etc., are considered. The NH β bands ($^3P \rightarrow {}^3S$) are briefly discussed. [See also Abstract 2051 (1927).] AUTHOR.

2530. *Argon Spectra in Extreme Ultra-Violet.* **H. B. Dorgelo** and **J. H. Abbink.** (Zeits. f. Physik, 41. 10. pp. 753–768, 1927.)—The red and blue argon spectra have been investigated from 1800 down to 400 Å.U. with a vacuum-grating spectrograph. As sources were used (*a*) a low-tension arc between the slit of the spectrograph as anode and an oxide-coated kathode; (*b*) kathode glow; (*c*) positive column; (*d*) a condensed discharge. Many lines "expected" in the "red" argon spectrum, calculated from the already known terms, were found in this region. In the "blue" spectrum in this region many lines were found, and the significance of these lines is discussed, based on constant differences found, and on the critical potential which these lines would imply. A. C. M.

2531. *The Green Aurora Line.* **G. Cario.** (Zeits. f. Physik, 42. 1. pp. 15–21, 1927.)—An exact measurement of the green oxygen line of McLennan and Shrum has been made. It is 5577·348 ± 0·005 Å.U. This value is identical with that measured by Babcock in the aurora, so that it must be ascribed to neutral oxygen. A. C. M.

2532. *Fine Structure in the Cs Spark Spectrum.* **A. Filippov** and **E. Gross.** (Zeits. f. Physik, 42. 1. pp. 77–80, 1927.)—The fine structure of the Cs spark spectrum has been investigated with a 30-step echelon grating. Six lines were found to be single: 4786, 4502, 4436, 4363, 4288 and 4265. Of the remaining eight lines investigated, 5249 was double, 5371, 5372 and 4527 were triple, 4953, 4830 and 4604 quadruple, while 5227 was sextuple. A. C. M.

2533. *Intensities in the Cs and K Spectra.* **A. Filippov.** (Zeits. f. Physik, 42. 7. pp. 495–498, 1927.)—The intensities were measured of lines due to these two elements using vacuum tubes containing admixed helium as sources. For Cs, two tubes were prepared; one contained helium at 1·5 mm., and the other helium at 110 mm. The intensities of the two components of the second number of the principal series (*viz.*, λ4555 and λ4593) were in ratios varying from 0·9 : 1 up to 3 : 1 for the second tube, and varying from 0·7 : 1 up to 2·7 : 1 for the first tube, according to the vapour density. This variation is attributed to the masking effect of self-reversal; photographs taken with an echelon grating make this more obvious. Intensity ratios in the diffuse and Bergmann series of Cs were entirely in agreement with the Burger-Dorgelo rules. Two diffuse and two sharp pairs were measured for K, and also were in agreement with the expected intensity ratios. A. C. M.

2534. *Intensities of Series Lines.* **B. Trumpy.** (Zeits. f. Physik, 42. 4. pp. 327–328, 1927.)—The intensities of the lines of the principal series of sodium were measured previously by the author [Abstract 541 (1926)]. These are now compared with the intensities of the lines of the Balmer series as reckoned by Pauli using Schrödinger methods. The agreement is good. A. C. M.

2535. *The First Lithium Spark Spectrum.* **H. Schüler.** (Zeits. f. Physik, 42. 7. pp. 487–494, 1927.)—The spectrum was produced, as previously described, by a glow discharge in pure lithium vapour, using a closed hollow kathode with a single slit. The ortholithium spark line 5485($2s - 2p_i$) was examined specially with an apparatus having great dispersion and resolving power. It was resolved into fourteen lines, one or two of which may be ghosts. According to Heisenberg the rough structure of this line represents a deformed triplet. The author discusses the possible groupings of the observed component lines and considers the possibility of some of them being due to an isotope effect; the possible effect of nuclear structure is also considered. The fine structure of some other lines has been examined. H. N. A.

2536. *Resonance, Fluorescence and Absorption Spectra in the Sixth Periodic Group.* **B. Rosen.** (Zeits. f. Physik, 43. 1–2. pp. 69–130, 1927.)—Resonance spectra in the vapours of Te_2, Se_2 and S_2 were excited by a mercury lamp and photographed with quarter and glass spectrographs, the spectra being analogous to the R-spectra of iodine. Tables of results are given and the fluorescence and absorption band spectra analysed. The effect of temperature and pressure is also considered. The relations of the frequencies of the component atoms in normal and excited states to the atomic numbers are considered and the heats of dissociation of the vapours determined by an optical method. F. S.

2537. *Measurement of h/k.* **E. Fermi** and **F. Rasetti.** (Zeits. f. Physik, 43. 5–6. pp. 379–383, 1927.)—The relations of the coefficients of the anomalous dispersion of the thallium lines λ3776 and λ5350 were measured at various temperatures. These relations confirmed Boltzmann's law for equilibrium between the two lowest conditions 6^2P_1 and 6^2P_2 for thallium. The ratio h/k was measured within 20 % A. D.

2538. *Intensity Distribution Within Spectral Lines.* **L. S. Ornstein** and **M. Minnaert.** (Zeits. f. Physik, 43. 5–6. pp. 404–412, 1927.)—This distribution is calculated on the hypothesis that the proper breadth of the line is very small and that its actual breadth is determined by diffraction and by the slit breadth. Measurements on photographed spectra agree with the theory under certain conditions. An array of applications in spectral photometry is given. A. D.

2539. *X-Ray Isochromats of Copper Taken in Different Directions Relative to the Kathode Stream.* **W. W. Nicholas.** (Phys. Rev. 29.

pp. 619–631, May, 1927.)—The variation with the potential of the intensity of monochromatic X-rays from 0·823 to 0·247 Å. was measured at different angles θ with the kathode stream. Within the limits of experimental error an isochromat of frequency ν varies linearly with the potential for potentials from about $5/4 H\nu$ to $2H\nu$, where $H\nu$ is the quantum voltage for excitation of frequency ν. The energy distribution in the X-ray continuous spectrum for $\theta = 90°$ did not agree with Kulenkampff's formula in detail, the voltages were higher and the target face inclination different from his. The spectrum at a forward angle appears to contain relatively more high-frequency rays than that at 90°, and that at a backward angle relatively more low-frequency rays. The energy distribution in the continuous spectrum from a thin target of copper was studied, using Webster's method. The results are discussed in relation to the theories of Kramers and of Wentzel, and are in fair agreement with both theories for a thick target. If certain assumptions made by the author are correct, Kramers' predicted thin target spectra are much more nearly in accord with the facts than are Wentzel's. H. N. A.

2540. *The Polarisation Factor in X-Ray Reflection.* **P. Kirkpatrick.** (Phys. Rev. 29. pp. 632–636, May, 1927.)—Shows that an X-ray beam consisting of a multiplicity of superposed polarised radiations will exhibit the same scattering distribution in a plane normal to the beam as one consisting of two plane polarised components of suitable intensity with mutually perpendicular planes of polarisation. The customary polarisation factor $\frac{1}{2}(1 + \cos^2 2\theta)$ does not apply to reflection of polarised radiation, and should be replaced by

$$\{\sin^2\alpha + P\cos^2\alpha + (P\sin^2\alpha + \cos^2\alpha)\cos^2 2\theta\}/(1 + P).$$

P is the primary polarisation ratio, θ the grazing angle on the reflecting crystal and α the angle between the plane of reflection and a plane defined by the incident beam and the direction of the kathode stream. For the usual orientation, with $\alpha = 0$, the polarisation factor reduces to $(P + \cos^2 2\theta)/(1 + P)$. Radiation from a tube with $\alpha = 45$ will be reflected with the same intensity as an equally intense unpolarised radiation, and the polarisation factor will be $\frac{1}{2}(1 + \cos^2 2\theta)$. A method of determining the value of P is described. H. N. A.

2541. *Dispersion Coefficient for Short Waves.* **J. A. Stratton.** (Phys. Zeits. 28. pp. 316–323, May 1, 1927.)—Critically working out the consequences of Schrödinger's theory [see Abstracts 55 (1927) and 2537 (1926)], the author arrives at a more generalised expression for the resultant electric moment on which dispersion depends. We are led to the conclusion, at variance with the classical theory, that in the region of high frequencies (hard Röntgen rays and γ-rays) the secondary radiation falls off with increasing frequency towards a limiting value O. The results are in harmony with Compton's views as to the large size of electrons. A. D.

2542. *Existence of Induction Effects from Suddenly Stopped Electrons.* **S. R. Milner** and **J. S. Hawnt.** (Phil. Mag. 3. pp. 1185–1195, May, 1927.)—The authors discuss on theoretical grounds the question of the nature of the radiation process when electrons are suddenly stopped at the anti-kathode in a vacuum tube. On the classical theory of the pro-

duction of X-rays, the radiation consists of a series of thin spherical pulses of electric and magnetic force spreading out radially from the stopped electrons. On these grounds an e.m.f. should be generated in a metal cylinder surrounding the anode. "Considerations of the energy of the pulses set a limit to the magnitude of the e.m.f., which is nevertheless of such a value that it should be capable of detection by a suitable galvanometer. Experiments show no trace of the existence of such an e.m.f. and add further evidence to the view that pulses of the kind formulated by the classical theory, if they exist, are not absorbed in accordance with classical considerations." The result is consistent with the view that radiation occurs in directed quanta and not in spreading pulses.
A. B. W.

2543. *Screening Constants from Optical Data.* **O. Laporte.** (Phys. Rev. 29. pp. 650–654, May, 1927.)—Grotrian [see Abstracts 1616 (1922) and 1377 (1927)] identified the relativistic doublets which correspond to the ionisation of an n_2 shell in the spectra of the rare gases. Similarly the doublets which belong to the n_3 shells are found in the spectra of 29 Cu, 45 Rh and 79 Au. The different relative stability of the n_3 electrons as compared with the $(n+1)_1$ electrons is clearly noticeable in every one of the three long periods. The screening constants are in good agreement with those computed from X-ray data, even in cases where the "optical" screening constant is obtained from elements the outer shell of which is not yet complete. AUTHOR.

2544. *Multiplets in Three Electron Systems of the First Long Period.* **R. C. Gibbs** and **H. E. White.** (Phys. Rev. 29. pp. 655–662, May, 1927.)—Using the regular and irregular doublet laws as guides, it has been found possible, from the corresponding known multiplets in Sc (I) and Ti (II), to identify the triad of multiplets of V (III) designated as $^4F_{2,3,4,5} - {}^4G_{3,4,5,6}$; $^4F_{2,3,4,5} - {}^4F'_{2,3,4,5}$; and $^4F_{2,3,4,5} - {}^4D_{1,2,3,4}$. For these multiplets the initial state is given by one $4p$ electron and two $3d$ electrons. In the final state the $4p$ electron has shifted to a $4s$ orbit. The separations of the $^4F_{2,3,4,5}$ levels are found to be in the ratio 2·50 : 3·52 : 4·50, in very close agreement with Landé's interval rule. The relative intensities of the lines in these multiplets conform to the usual rule. A comparison of the data for one, two and three electron systems of Sc, Ti and V shows that the addition of first one and then a second d electron causes not only an increase in the multiplicity but also successive shifts in the radiated lines toward the longer wave-lengths by very nearly the same frequency interval. It has also been found possible to identify the $^4F_{2,3,4,5} - {}^4F'_{2,3,4,5}$ multiplet of Cr (IV). AUTHORS.

2545. *Position of the K Absorption Limits of Vanadium in its Compounds.* **S. B. Hendricks** and **R. W. G. Wyckoff.** (J. Phys. Chem. 31. pp. 703–712, May, 1927.)—The X-ray K absorption spectra of vanadium compounds, in which the valency exhibited by vanadium varies from 2 to 5, have been measured. The K absorption limit varies from 2256·8 for V_2O_5 to 2263·2 X.U. for vanadium metal. That this difference is not solely dependent on the valency is demonstrated by the fact that variations from 2256·2 to 2258·2 are exhibited by pentavalent vanadium compounds. Other factors suggested as influencing the K absorption limit are (1) the physical state of the compound; (2) the number of atoms associated with vanadium, *i.e.*, in $NaVO_3$ and Na_3VO_4; (3) changes in the atoms forming the group containing vanadium, *e.g.*, Na_3VO_4, Na_3VS_3O, Na_3VS_4; (4) polymorphism. L. M. C.

2546. *Spark Lines in the K X-Ray Spectra of Na, Mg and Al.* **T. Wetterblad.** (Zeits. f. Physik, 42. 8. pp. 611–613, 1927.)—The spark lines of Na, Mg and Al have been photographed with greater intensity than previously, by using extremely thin aluminium foil on slit covering. The wave-lengths of the lines α_5 and α_6 of Na are measured for the first time, and the rest more accurately. The wave-lengths are in agreement with Wentzel's theory. A. C. M.

2547. *Precision Measurement of the K-Series of Molybdenum and Iron.* **A. Larsson.** (Phil. Mag. 3. pp. 1136–1160, May, 1927.)—A detailed description of a precision spectrograph developed at the Physical Laboratory of the University of Upsala, and intended for a wave-length range of 0·4–2·5 Å.U. In addition, results are given of the measurement of the K-series of iron and molybdenum. [See Abstract 109 (1920).] AUTHOR.

2548. *Relation between the Intensity of the Lines of the X-Ray Spectrum and the Voltage.* **D. Nasledow** and **P. Scharawsky.** (Zeits. f. Physik, 43. 5–6. pp. 431–441, 1927.)—The K-spectra of Mo, Ag, Pd and Cu were investigated by the ionisation method. Voltages were employed on the X-ray tube ranging from 65 to 125 kV, the maximum being five or six times as great as the excitation voltages of the above elements. The relation between the intensities of the lines AgKα, AgKβ, PdKα, PdKβ, MoKα and the squares of the voltages was found to be strictly linear. The straight line cuts the axis of abscissæ at points corresponding to the excitation voltages, V_g, of the series, so that the intensity is given by the equation $I = c(V^2 - V_g^2)$, this agrees with Kettmann's formula for low voltages. The intensity of CuKα increases more slowly with the square of the voltage between 65 and 90 kV than at lower voltages, but the relation appears to be linear in this part of the range. H. N. A.

2549. *A Contribution to a Wave Mechanical Theory of the Fraunhofer Diffraction Phenomena.* **G. Wataghin.** (Zeits. f. Physik, 42. 7. pp. 555–561, 1927.)—The diffraction of Röntgen rays at crystal lattices and the Fraunhofer diffraction phenomena in the optical field afford excellent opportunities for the application of the Schrödinger wave mechanics, and the investigations of Duane [see Abstract 2430 (1923)], Compton [see Abstract 415 (1924)], Epstein and Ehrenfest [see Abstract 1812 (1924)] point to a method for the application of the Schrödinger theory to macroscopic lattices. The present author accordingly treats the Duane theory of the infinite lattice from the latter standpoint. For the finite linear and space lattices, the correct intensity distribution has been obtained on an assumption with respect to the physical significance of the field scalar ψ, which deviates somewhat from that of Schrödinger. H. H. Ho.

2550. *The Natural Width of Röntgen Emission Lines.* **W. Ehrenberg** and **H. Mark.** (Zeits. f. Physik, 42. 11–12. pp. 807–822, 1927.)—Two methods are given for measuring the width of Röntgen emission lines: (1) Photography and comparison of different orders; the width increases with the order. (2) Ionisation-compensation method, using two reflections from the same kind of crystal. Both methods agree closely in results—the spectral widths of MoK, K, and Rh.K are 0·204, 0·199, and 0·175 X.U. which exceed some three or four times the values calculated on the method of classical radiation damping. J. E.

2551. *The Natural Width of Röntgen Emission Lines.* **W. Ehrenberg** and **G. V. Susich.** (Zeits. f. Physik, 42. 11–12. pp. 823–831, 1927.)—An extended application of the method described previously [see preceding Abstract] using calcite as the reflecting crystal. A table of results is given. J. E.

2552. *Theory of the Compton Effect.* **G. Wentzel.** (Zeits. f. Physik, 43. 1–2. pp. 1–8, 1927.)—The Compton effect has previously been treated in undulatory mechanics only for the limiting case of free electrons. The paper develops the theory for loosely-bound electrons in which the Compton "modified" line appears as an intensely maximum in the continuous spectrum of the Smekal scattered radiation [Naturwissensch. 11. p. 873, 1923]. The calculated frequency and intensity of the modified and unmodified lines are in agreement with experiment. W. V. M.

RADIOACTIVITY.

2553. *Radioactivity of the Earth's Basaltic Magna.* **J. H. J. Poole.** (Phil. Mag. 3. pp. 1246–1252, May, 1927.)—In earlier tests doubt existed regarding the radioactivity of specimens of Oregonian plateau basalt, and further measurements have been made on authentic specimens. The results now agree with other plateau basalts. Tests were also made on various eclogites. These have the same gross chemical composition as ordinary basalt but a different mineral constitution and density. They are probably from the lower layers of the earth's basaltic magna, and the radium and thorium contents confirm the view. The electric method used is that explained earlier [see Abstract 373 (1925)] with slight modifications. The following mean results are obtained from a large number of tests:—

	Ra X: 10^{-12} gm. per gm.	Th X 10^{-5} gm. per gm.	Density gm./c.c.
Eclogites	0·33	0·18	3·376
Plateau Basalts, Oregonian	0·70	0·57	2·897
Plateau Basalts, Deccan	0·77	0·46	2·982
Plateau Basalts, Hebridean	0·77	0·49	2·912
Island Basalts, Atlantic Islands	1·31	0·87	2·954
Island Basalts, Pacific and Indian Ocean Islands	0·99	0·46	2·827

R. S. R.

2554. *Relations between the Radioactivity in and about the St. Joachimsthal Mines.* **F. Běhounek.** (Phys. Zeits. 28. pp. 333–342, May 1, 1927.)—The activity of a number of springs in the mines was measured. One of these was a thermal spring at the bottom of the Einigkeitsschacht. The others are divided into two kinds, those the water of which has not flowed over rich masses of uranium ore, and which have derived their radioactivity from the air contained in the rocks, and rarer springs in which the water has dissolved radioactive material from rich ore masses. Observations were also made on the air in the mine passages and in their walls, on the air in the ground above the mines, and at several places in the open. Near the above-mentioned mine shaft the atmospheric radioactivity was high, but at a short distance it did not differ much from that at places where there is no strongly radioactive rock underneath. It seems probable that the amount of emanation in the ground has only a slight influence on the ionisation of the atmosphere, which may be mainly due to the penetrating high altitude radiation. H. N. A.

2555. *The Daily Period of High Altitude Radiation.* **W. Kolhörster** and **G. v. Salis.** (Preuss. Akad. Wiss. Berlin, Ber. 11. pp. 92–104, 1927. From the Reichsanstalt.)—Describes measurements taken commencing in August, 1926, at various stations in the Jungfrau region, chosen so that different portions of the heavens were screened by surrounding mountains, while one set was taken at the summit of the Mönch, where there was no such screening. Another set was taken at the bottom of a conical pit in the ice, the sides of which formed a screen which prevented radiations from portions of the heavens at a distance from the zenith from affecting the instrument. The maxima and minima observed in this case occurred at the same sidereal times as those at the summit. When the portions of the heavens were screened by the mountains about the stations the times of the maxima and minima were affected, and conclusions were drawn as to the positions in the sky of the radiating sources. Corlin suggests that the Mira stars are concerned, and this seems to be confirmed by the observations. H. N. A.

2556. *Grouping of Atoms of Radioactive Elements in Mercury.* **(Miss) C. Chamié.** (Comptes Rendus, 184. pp. 1243–1245, May 23, 1927.)—When radioactive elements are dissolved in mercury they do not form a homogeneous solution, but collect in patches, having a diameter not much greater than the micron, since the α-rays produce "stars" on photographic plates, the rays of which are 34 microns for ThC, 61·5 microns for ThC′, and 27 microns for polonium. T. M. L.

2557. *Radioactivity of Lead Subjected for a Long Period to Solar Radiation.* **(Miss) S. Maracineanu.** (Comptes Rendus, 184. pp. 1322–1324, May 30, 1927.)—The authoress has already described the weak but somewhat persistent radioactivity of commercial lead after exposure to sunlight [see Abstract 761 (1926)]. She has now made observations on the old lead roof of the Paris Observatory, using a very sensitive Sziland electrometer, the ionisation chamber of which had a removable aluminium bottom. Measurements were made, first with and then without the aluminium bottom; in the latter case the radiations from the lead below it could enter the chamber directly. The observations show a definite radioactivity of the old lead roof, the radiation being due in the main to α-particles, though there may be some weak penetrating radiation. **Deslandres** (*ibid.*, pp. 1324–1325) remarks on the above communication. H. N. A.

2558. *A New Method of Studying the Electrolytic Deposits of Radioelements.* **Joliot.** (Comptes Rendus, 184. pp. 1325–1327, May 30, 1927.)—The electrode on which the radioactive element is deposited forms the bottom of the vessel containing the electrolyte, and is thin enough to transmit the radiation from the element deposited on it. The radiation passes into an ionisation chamber, and the saturation current is measured. The electrode consists of a layer of gold about 40 $\mu\mu$ thick, deposited by kathodic pulverisation on a sheet of mica weighing 1·5 mg. per sq. cm. The author has studied by this means the rate of deposition of polonium as a function of the potential of the electrode, and gives curves showing the relation between them. H. N. A.

2559. *A Search for Radioactive Products of Atomic Disintegration by α-Particles.* **H. Müller.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 10. pp. 563–572, 1926.)—The following elements have been subjected to intense α-radiation; uranium, lead, copper, carbon, bismuth, selenium, antimony, tin, tellurium, thallium and thorium; and then tested for induced radioactivity. The results were in all cases negative. H. N. A.

2560. *Penetration of Polonium into Metals.* **E. Rona** and **E. A. W. Schmidt.** (Akad. Wiss. Wien, Ber. 136. 2a. No. 1–2. pp. 65–73, 1927.)—Describes a method for coating the thin metal foil employed with polonium, on one side only. The scintillation method was employed to find out if there was any penetration into the metal of the foil; the side free from polonium was placed opposite the phosphorescent screen, and observations were made at intervals. Rapid penetration would cause an increase, in the course of time, of the number of scintillations produced by α-rays from the polonium which pass through the foil; there was no abnormally high velocity of diffusion for any of the metals studied. The observations on lead contradict the views of S. Maracineanu, and lead to the conclusion that the results obtained by her were due to a wandering of the polonium over the surface of the lead. H. N. A.

2561. *Scattering of α-Particles.* **J. R. Oppenheimer.** (Zeits. f. Physik, 43. 5–6. pp. 413–415, 1927.)—Wentzel has derived the Rutherford formula for the deviation of α-particles by atomic nuclei, using quantum mechanics, but employed a screened potential $U = -E_1/re^{-rR}$ instead of the usual Coulomb potential [see Abstract 1495 (1927)]. The author shows, however, that the Rutherford formula can be derived from the simple Coulomb law, without considering the electronic structure of the atom. It is shown that the deviations from Rutherford's law in the case of particles with very high velocity cannot, in all probability, be explained without further hypotheses as to the structure of the particles. H. N. A.

2562. *α-Rays and Atomic Structure.* **E. Rutherford.** (Engineering, 123. pp. 375–376, April 1; 409–410, April 8; 460–461, April 15, and pp. 492–493, April 22, 1927. Paper read before the Royal Inst.)—The lecturer gave an historical treatment of the discovery of α-rays, and in illustration made use of an apparatus designed by Williams, which magnifies one million times the current resulting from the ionisation of a gas by α-rays; this consists of two valves in neighbouring arms of a Wheatstone bridge, balanced by two resistances. The grid of one of the valves is connected to the ionisation chamber electrode. The author's own work and that of Bragg, Madame Curie, Wilson, Joly, Briggs, Kapitza, Bieler, Chadwick and other experimenters are dealt with, attention being devoted to α-ray ranges, the heliochroic halos produced by α-rays in mica, the disappearance of the rays while the particles are still moving at a high speed, the loss of the negative charge by picking up one and later two electrons, straggling, δ-rays, the loss of energy to an atomic or molecular electron which makes a quantum jump, or is expelled with a certain velocity, the scattering of α-rays by matter, which in the case of copper, silver, gold and uranium takes place with no indication of a breakdown of the inverse square law of repulsion for very close approaches to the centre of the atom, with light elements there is a complete breakdown. The lecturer described his theory of nuclear structure, deduced from the above facts, and dealt with the relation between the new wave mechanics and close encounters between α-particles and atoms. H. N. A.

2563. *Intensity Distribution in the Spectrum of γ-Rays from RaC.* **D. Skobelzyn.** (Zeits. f. Physik, 43. 5–6. pp. 354–378, 1927.)—The paths of β-rays produced in a Wilson cloud chamber by a narrow bundle of γ-rays were photographed stereoscopically with the help of a magnetic field. Under selected conditions the values of the reflected energy $H_{\rho \max.}$ have been measured for the scattered reflected electrons. For each ray the angle between the reflected and incident rays has been measured with a stereocomparator. On the basis of these measurements the primary frequency for the corresponding reduced values of $H_{\rho \max.}$ have been calculated. The statistical distribution obtained shows strongly expressed frequency maxima which, on the basis of the Debye-Compton equation for the strongest γ-lines, correspond to the calculated $H_{\rho \max.}$ values. It provides also a quantitative confirmation of this equation for the elementary scattering process. The comparison of the observed frequency distribution with that measured by Ellis in the natural β-line spectrum shows that the intensity of the primary γ-lines can be obtained from the photographically registered intensity of the secondary β-rays, in that the latter is multiplied by a factor $f(\lambda)$, which increases as λ decreases. Other conclusions regarding the intensity distribution in the primary γ-ray spectrum are drawn. β-rays of unknown origin and of extraordinary high energy (>20·000 kV) have been found. R. S. R.

2564. *Ionisation by H-Rays.* **Marietta Blau** and **Elisabeth Rona.** (Akad. Wiss. Wien, Ber. 135: 2a. No. 10. pp. 573–585, 1926.)—A method is described for measuring the ionisation produced by natural H-rays; α-rays from a polonium preparation free from penetrating radiation were employed, and were passed through a thin layer of paraffin wax, from which they drove H-rays through an aluminium window into a small ionisation chamber. Ionisation curves were obtained by introducing additional sheets of mica into the path of the rays before they entered the chamber, thus reducing their velocity. The range deduced from these curves is greater than the theoretical one, but this may be due to the action of some other kind of radiation. From an estimate it appears that the measurements of ionisation are in good agreement with the assumptions that Geiger's law holds for H-particles, and that the ionisation is proportional to the kinetic energy of the particles. Experiments are described which show the ionising effect of H-particles produced in a similar manner from aluminium, which are products of atomic disintegration by α-rays. H. N. A.

HEAT.

2565. *Thermal and Electrical Conductivity of a Single Crystal of Aluminium.* **E. Griffiths.** (Roy. Soc., Proc. 115. pp. 236–241, June 1, 1927.)—The specimen of aluminium examined (99·6 % Al) was shown by X-ray analysis according to the rotating crystal method to be a single crystal with a face-centred cubic structure, the axis making angles of 114·3°, 80·7°, and 25·6° with the three coordinate axes. The thermal conductivity of the crystal is practically identical with that of an extruded bar of ordinary aluminium, this result being in agreement with the observation that the mean conductivity of a bismuth crystal corresponds with that of a rod of cast bismuth. The value of the conductivity is exceptionally high, in accord with the high purity of the metal. The temperature coefficient of the thermal conductivity has a slight positive value. The specific resistivity at 18° C. is $2\cdot89 \times 10^{-6}$ ohm per cm. cube. The value of the Lorenz constant, $K \div \lambda T$, where K and λ are respectively the thermal and electrical conductivities and T the absolute temperature, is $5\cdot46 \times 10^{-9}$, this falling within the range of values published for pure metals, namely, $5\cdot3 - 6\cdot0 \times 10^{-9}$. T. H. P.

2566. *Derivation of the Wiedemann-Franz Law from the Second Fundamental Law.* **A. March.** (Ann. d. Physik, 83. 2. pp. 296–302, June 8, 1927.)—A simple explanation of the Wiedemann-Franz-Lorentz law has been given on Drude's electronic theory of metals, but inherent difficulties arise which are now discussed. It is then shown that the law can be derived in a somewhat more generalised form from the second law of thermodynamics with no further assumption other than that the thermal conduction of metals is facilitated by electrons. H. H. Ho.

2567. *Heat Transfer and Turbulence.* **H. Lorenz.** (Phys. Zeits. 28. pp. 446–448, June 15, 1927.)—Coefficients of heat exchange, resistance, and velocity referring to a hot stream of gas flowing in a cylindrical pipe are correlated. Satisfactory agreement with the theoretical deductions is afforded by Nusselt's results. [See also Abstract 2422 (1925).] J. S. G. T.

2568. *Latent Heat of Benzene above the Boiling Point.* **J. A. Sutcliffe, F. C. Lay** and **W. L. Prichard.** (Roy. Soc., Proc. 115. pp. 88–102, June 1, 1927.)—Gives details of a method by which the heat of vaporisation of liquids may be accurately determined at temperatures above their boiling points. The application of the method to benzene gave consistent results (at approx. 87, 105, 125, 143 and 152° C.) in agreement with the results of Griffiths and Marshall (at approx. 20, 30, 40 and 50° C.). *All* results between 20 and 152° C. are given by $L = 106\cdot868 - 1\cdot47106 \times 10^{-1}t - 1\cdot46582 \times 10^{-4}t^2 - 3\cdot60266 \times 10^{-7}t^3$, in which L is the heat of vaporisation and t is temperature. W. H. Ge.

2569. *Criticism of the Electrical Differential Method for the Measurement of the Specific Heat, C_v, of Gases.* **M. Trautz.** (Ann. d. Physik, 83. 4. pp. 457–497, June 28, 1927.)—The molecular heat of gases at constant volume was not measured directly but only obtained by comparison with argon for which it is accepted that $C_v = 3R/2$. Further, the temperature increase was not obtained directly but only by a manometric null method in which the increase of pressure due to rise of temperature is balanced against that of another gas, the gas thus acting as its own thermometer. Heating of the gas gives rise to local irregularities in the interior, the gas being a bad conductor of heat. The principle of the electrical differential method for the measurement of C_v is developed up to the use of the final equations, and the limits of accuracy are explored. The errors and corrections involved are examined in great detail, and the methods of avoiding or measuring them. Under the assumptions made it could be shown that the accuracy of the values of C_v reached with the apparatus used was about that for the definition of the numerical value of R, the gas constant. This leads to the result that it is now possible to measure C_v in the ideal gas state for very many substances, all of which have a vapour pressure at room-temperature of a few mm. Hg. One thus obtains C_v as accurately as has been the case hitherto for pure gases. R. S. R.

2570. *Heat Capacities of Liquid Metals.* **A. L. Dixon** and **W. H. Rodebush.** (Am. Chem. Soc., J. 49. pp. 1162–1174, May, 1927.)—The heat capacities of some molten metals at several temperatures have been measured using a method suggested by Lewis ("Thermodynamics," 1923, p. 137). The pressure on the liquid was changed suddenly and the consequent change in temperature determined by a thermocouple. Then by application of the equation $(\partial T/\partial P)_s = T/C_p(\partial v/\partial T)_p$, C_p was calculated, the required coefficients of expansion being obtained from the literature. For the above equation to be valid, the entropy must remain constant, which necessitates that no current should be produced in the liquid by the change in pressure, and that the heat exchange with the surroundings be negligible in the time required by the thermocouple to attain equilibrium with the liquid. Experimental precautions were taken to satisfy the second of these conditions. The metals for which the constant was determined were mercury, sodium, potassium and lead. [See also Abstract 1846 (1914).] L. M. C.

2571. *Course of the Melting-Point Line of Helium at Very Low Temperatures.* **J. J. van Laar.** (K. Akad. Amsterdam, Proc. 30. 2. pp. 244–248, 1927.)—In Keesom's paper [see Abstract 1061 (1927)] on solid helium it was suggested, on the strength of the course of the melting-point line down to about 1° abs., that $(dp/dt)_{\text{coëx.}}$ should approach O when T approaches O. The author objects to such a conclusion, which would involve that the melting heat ϕ would approach O according to a higher power of T than $T(v_2 - v_1)$, a quantity which is not only determined by the difference of the thermic energies, but also by the much more important difference of the potential energies. Accordingly, the shape of the melting-point line in the neighbourhood of $T = O$ is discussed, and also the course of the melting heat ϕ, whereby Keesom's conclusion is shown to be invalid. H. H. Ho.

2572. *Apparatus for Determining the Mechanical Equivalent of Heat.* **U. Adelsberger.** (Phys. Zeits. 28. pp. 375–377, May 15, 1927.)—Illustrated description of an apparatus tested at the Königsberg Physical

Institute and found to give good results. Constructional details should be studied in the original. E. F.

2573. *Application of Salicylic Acid as a Calorimetric Standard.* **E. Cohen, P. E. Verkade, S. Miyake, J. Coops, Jr., and J. A. v. d. Hoeve.** (Zeits. Phys. Chem. 126. 3-4. pp. 290-296, April, 1927.)—Determinations of heats of combustion in oxygen of salicylic acid prepared by crystallisation from different solvents show that constant reproducible values are obtained only from material which has been recrystallised from dry ether, powdered, and dried *in vacuo* over P_2O_5 for several weeks. The mean value thus obtained for the heat of combustion in oxygen is 5243·4 gm./cal. (15° C.). The deviations obtained with the substance crystallised from water are attributed to water occluded in the crystals which is not eliminated by storing *in vacuo* over P_2O_5 or heating to 100° — 105° C. for several hours. J. N. P.

2574. *Viscosity of a Gas Composed of Sutherland Molecules of a Particular Type.* **H. R. Hassé** and **W. R. Cook.** (Phil. Mag. 3. pp. 977-990, May, 1927.)—Chapman's formula for the viscosity of a gas is applied to the case of a gas conforming to the Sutherland type, the results showing close agreement with experimental data for argon and nitrogen. Comparison in the case of helium indicates that a model of the Sutherland type is not applicable to this gas. A. B. C. L.

2575. *Vibrational Movements Occurring During the Inflammation of Combustible Gases.* **J. D. Morgan.** (Phil. Mag. 3. pp. 1161-1166, May, 1927.)—Experiments are described in which mixtures of coal-gas and air, and of methane and air, are exploded in closed tubes of definite dimensions, both the general and the vibrational variations of pressure being recorded by a photographic device. The results are discussed in relation to "pinking" in high-speed internal-combustion engines, and it is concluded that the phenomenon is due to a suitable correlation of two factors—the rate of generation of heat in the flame front and the vibration frequency of the gas in the direction of travel of the flame. A model which may be used in assisting the study of vibrational movements similar to those set up in a gas column consists of a black enamelled helical spring hung at one end on a rigid support and strongly illuminated on one side. The increase of amplitude of the vibrations of individual convolutions consequent upon increase of suddenness of impulse applied at the free end is evidenced by the lengthening of bright lines reflected from the convolutions. Reference is made to the relations between the production of "pinking" and design of cylinder and of ignition position. A. B. C. L.

2576. *The Nernst Heat Equation and the Unattainability of the Absolute Zero.* **H. Mache.** (Akad. Wiss. Wien, Ber. 136. 2a. No. 1-2. pp. 75-80, 1927.)—A theoretical note discussing the application of Planck's theory to the Nernst equation. It is shown that in the neighbourhood of the absolute zero the total differential of the entropy is equal to zero, and the unattainability of the zero point is possibly explained. S. G. B.

SOUND.

2577. *Double Symmetrical or Asymmetrical Sounding Pipes.* **Z. Carrière.** (J. de Physique et le Radium, 8. pp. 215–224, April, 1927.)—The sounding pipe constructed by the author and shown in an illustration consists of two parts separately detachable, so that it may be made to vibrate as an ordinary pipe, as a double symmetrical or a double asymmetrical pipe. The double symmetrical pipe, suitable for verifying the fundamental principle of interference, has always a higher frequency than its component pipes. When the double pipe is asymmetrical its frequency, always higher than that of the deeper pipe, may be, according to the asymmetry, equal to or less than that of the more acute one. The deeper pipe may have a real ventral segment near its orifice. A comparison of the corrections at the orifice and the counter-orifice leads to the conclusion that these corrections might furnish a measure of the energy imparted to vibrating media. Experiments point to a new method of measuring frequencies by means of a detached phonic turbine or of a stroboscopic disc. Frequencies of 2500 s^{-1} are easily measured. [See Abstract 1614 (1926).] E. F.

2578. *Intensity of Compound Tones and Sounds.* **H. Barkhausen and H. Tischner.** (Zeits. techn. Physik, 8. 6. pp. 215–221, 1927.)—A measure of the physiological intensity of given tones or sounds may be obtained by comparison with the intensity of a normal tone. Pitch and timbre of the normal tone do not affect the result. The intensities thus found agree with the measurements of Barkhausen and Lewicki made by the method of threshold values [see Abstract 622 (1925)], but the newer method is more accurate and easier to apply. The theorem that the intensity of a sound is equal to that of the physiologically loudest overtone and that the remaining partial tones, if not differing more than 20 % in frequency, do not increase the loudness, is confirmed also for greater intensities. Experiments with interrupted direct and alternating current are described and found to be in complete agreement with the above theory. The accuracy of the comparative measurement is, for normal intensities, within about 10 % of error. This percentage is exceeded only in the case of very great or very small intensities. By taking the mean of several values the error may be reduced to about 5 %, but such accuracy is achieved only with practice and elimination of all disturbing factors. The paper contains numerous curves and is partly mathematical. E. F.

2579. *The Regular Combination of Acoustic Elements, with Applications to Recurrent Filters, Tapered Filters and Horns.* **W. P. Mason.** (Bell System Techn. J. 6. pp. 258–294, April, 1927.)—Starting with Rayleigh's equation for the propagation of plane waves of sound in a tube of uniform cross-section, a solution is found and expressions are obtained for the excess pressure and volume velocity at any section in terms of the constants of the tube and its specific characteristic impedance. The effect of a junction is allowed for by using the equivalent of Kirchhoff's laws, with the additional proviso that end-corrections shall be added to tubes entering a junction. Equations are then formed with the aid of which may be obtained the propagation characteristics of any structure employing straight tubes, side branches, and changes in area of tubes. These include recurrent filters, which consist of a main tube with equally-spaced side-tubes. This type is discussed both as a low-pass and a high-pass filter. Tapered filter structures and horns exercise a species of transformer action, and horns are the limiting cases of tapered filters. Exponentially tapered filters and horns are discussed and their complete equations are found. It is shown that no low-pass filter exists in exponentially tapered structures. If straight tubes are employed, and the distance between successive changes in areas is made small, the horn equations obtained are those first developed by Webster. The general combination of acoustic elements is discussed in the final section. In appendices are given a proof of Thévenin's theorem for an acoustical system, and a determination of the loss, for a source which sets up a constant volume velocity, such as the phonograph. [See Abstract 911 (1925).] G. E. A.

2580. *Explanation of Abnormal Sound Propagation.* **F. Nölke.** (Phys. Zeits. 28. pp. 302–304, April 15, 1927.)—The high rate of travel of the sound waves which reach the outer zone of audibility justifies the conclusion that they are not confined to the troposphere layers, but that they also pass through certain layers of the stratosphere. As to the physical causes of their backward curvature in the stratosphere, no agreement has yet been reached. Seismic methods require the assumption that at the vertex of its path the sound has a speed exceeding its normal rate at the earth's surface. To explain this it is supposed that the stratosphere consists largely of hydrogen and helium or is of a higher temperature than the layers near the earth's surface, or that in elevated regions the sound waves are propagated like explosive waves [see Abstracts 1077, 1871 (1926)]. It is, however, possible that an important circumstance has been overlooked which may throw some light on the question. The assumption that the greater part of the sound path lies with only slight curvature in the interior of the lower stratosphere layers is open to the objection that the known temperature and composition of these layers are not physically consistent with a reversal of the waves. On the other hand, the seismic method of constructing sound rays takes only direct rays into consideration and leaves out of account those which are continually being formed by diffraction in the zone of silence, even at a great distance from the source of sound. In accordance with the Huygens principle, oscillation in the wave region produces also in the zone of silence a state of oscillation resulting from interference. That zone must therefore be considered as an acoustic field, and the problem is to determine the state of excitation at each point of the field. Observations on water waves lead by analogy to certain conclusions and enable the process of diffraction to be pictured in its broad outlines. The earthward curvature of the sound waves is favoured by inversions in the troposphere. As there is a marked difference between the formation of the outer zone of audibility in summer and winter, and inversions are more frequent and on an average stronger in the latter season, the effect of diffraction may not be sufficient to account for the phenomenon. Very powerful inversions may, however, sometimes render diffraction superfluous. The explanation of the outer zone of audibility by diffraction in conjunction with inversions in the troposphere was advanced several years ago [see Abstracts 1368 (1916) and 183 (1918)] and upheld by H. Morf (Jahresber. Schweiz. Erdbebendienstes 1918, Suppl.). It may be well to redirect attention to it in the face of the important new observational data now available and of the great difficulties encountered by other explanations. The analogy with water waves is illustrated by curves. E. F.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2581. *The Smallest Electricity-Carriers in Gases.* **H. Schilling.** (Ann. d. Physik, 83. 1. pp. 23–79, May 23, 1927.)—The various factors influencing the velocity of electricity-carriers in pure air are submitted to experimental investigation by means of improved methods, and the results obtained discussed in relation to the literature of the subject. In spite of the great care taken, it is found impossible, even with the purest gases, to obtain appreciably greater velocities than those usually ascribed to electricity-carriers in air. The greatest values found are $w_- = 2\cdot 5\ \frac{\text{cm.}}{\text{sec.}} : \frac{\text{volt}}{\text{cm.}}$ and $w_+ = 2\cdot 00\ \frac{\text{cm.}}{\text{sec.}} : \frac{\text{volt}}{\text{cm.}}$, which correspond with radii of $4\cdot 1$ and $4\cdot 7 . 10^{-8}$ respectively. The radius of the electricity-carrier thus appears to be about thrice that of a single air molecule. The assumption of action at a distance to explain the slight mobility of ordinary electricity-carriers seems unjustified, and evidence is adduced in support of the view that these carriers are complexes of several gas molecules of approximately the magnitude calculated without assumption of action at a distance.

Hence, it may be concluded that, immediately after formation, the originally monomolecular positive or negative carrier takes up in air—even when this is so free from moisture as not to tarnish bright sodium—some four or five molecules of air. Unless special precautions are taken, the gases used will contain traces of vapours such as water vapour adherent to the glass containing walls, the velocities of the carriers of either sign being then reduced from the values given above to about $1\cdot 8$. The molecular complex corresponding with this velocity must possess a certain stability, since it is readily reproducible. If organic vapours are present, these are fixed preferably by the positive carrier and depress the velocity further. The fat and rubber vapours present under ordinary experimental conditions result in the value $w_+ = 1\cdot 35$, and in presence of ethyl diazoacetate still lower values are found. If the gas is saturated with water vapour, w_- assumes the value $1\cdot 4$. The assumption of these final values is generally very rapid. Similar behaviour is observed in the case of nitrogen, except that, when only N_2 molecules are present, the electrons appear to remain in the free state. A few oxygen molecules are not able to retain the electrons they absorb but give them up on impact with nitrogen molecules. Only when so many oxygen molecules are present that an O_2-carrier, before it yields up its electron, meets other O_2^- or other similar molecules, is the electron retained. [See also P. Lenard, Abstracts 1180, 1320 (1913).]

T. H. P.

2582. *A Generalisation of Electrodynamics, Consistent with Restricted Relativity and Affording a Possible Explanation of the Earth's Magnetic and Gravitational Fields, and the Maintenance of the Earth's Charge.*

W. F. G. Swann. (Phil. Mag. 3. pp. 1088–1136, May, 1927. Paper read before the Am. Mathematical Congress and the Am. Phys. Soc.)—The Maxwellian electromagnetic and force equations are generalised in such a manner as to account for a slow death of positive electricity amounting to a loss of 0·5 % of the earth's mass in 10^{20} years, and so as to leave a continually increasing surplus of negative electricity which, after building up the necessary electric field, passes off as the atmospheric electric current. The generalised equations yield approximately the same expressions for the field as those given by the classical theory. There is produced, however, in the case of a rotating neutral earth, a fictitious current density and a fictitious charge density. Invariants entering into the specification of these fictitious magnitudes are chosen so that the theory gives the correct ratio of the magnetic field of the earth to that of the sun, and predicts for a small sphere rotating at the highest attainable speed a magnetic field and a rate of death of charge which would be measurable only with extreme difficulty. Gravitation is provided for by a replacement of the force equation by two equations for the motions of positive and negative electrons respectively, the modification implying a difference in the forces between equal like and equal unlike charges. The whole scheme of relations is invariant under the transformation of the restricted theory of gravitation. J. S. G. T.

2583. *Note on E. Weber's Paper "Conformal Representation and Electrotechnics.* **P. Andronescu.** (Archiv f. Elektrot. 18. pp. 265–266, May. 11, 1927.)—In Weber's paper [see Abstract 430 (1927)] an error is pointed out in the author's treatment of two-dimensional and axially symmetrical fields [see Abstract 1488 (1925)]. The present mathematical note points out errors in Weber's paper. H. H. Ho.

2584. *Calculation of the Mean Values in the Lorentz Theory of Electrons.* **V. Bursian.** (Zeits. f. Physik, 43. 5–6. pp. 416–426, 1927.)—The mean values of the quantities relating to the currents and the charges in the electron theory are derived by means of the Lagrange series development; the method differs in its details from the method of variations employed by Minkowski and Born and by Fokker, but appears to lead to the same results in a somewhat simpler manner. The mean values in question are those which are expressed by such quantities as polarisation and magnetisation, which in general cannot be defined uniquely. After the exact calculation of the mean values the author considers what are the conditions under which, in spite of this, the mean values can be considered as having a single definite meaning. H. N. A.

2585. *The Magnetic Field due to a Current.* **J. Koenigsberger.** (Phys. Zeits. 28. pp. 342–344, May 1, 1927.)—A short mathematical paper discussing the magnetic field in space due to a current flowing in a conductor, when the conductor has finite length and is not necessarily of circular cross-section. G. E. B.

2586. *Electrostatic Problem of Two Conducting Spheres.* **A. Russell.** (Inst. El. Eng., J. 65. pp. 517–535, May, 1927.)—A continuation of a previous paper [see Abstract 2925 (1926)], discussing capacities, mutual actions and fields in the neighbourhood of two electrified spherical conductors. Formulæ are developed from which the capacity coefficients may be computed to any desired degree of accuracy. Formulæ are also developed for use in calculating the potential gradients at the points on the spheres where the line joining their centres cuts the surfaces. G. E. B.

2587. *Dielectric Attraction in Electric Fields.* **G. L. Addenbrooke.** (Phil. Mag. 3. pp. 1166–1184, May, 1927.)—An account is given of the effects produced on liquid dielectrics in shallow earthed containers by the juxtaposition of charged metal electrodes of various shapes. The dielectrics employed include rosin oil, castor oil, turpentine, and mineral oils. With dielectrics not specially cleaned and purified, using spherical electrodes, confused risings of the liquids occur, accompanied by hollows and often whirling motions. With clean, dry dielectrics the phenomena are simplified to a simple attraction of the dielectric to the charged sphere, without reference to its polarity. With point electrodes a depression is produced. Similar respective effects are observed when the electrodes are encased in glass sheaths. Similar, but less localised, effects are produced with pure water, and with aqueous solutions of pure salts.

A. B. C. L.

2588. *Frictional Electricity: Experiments and Reflections.* **J. Tagger.** (Phys. Zeits. 28. pp. 365–375, May 15, 1927.)—Describes the method adopted for generating frictional electricity by impact. The results of the experiments are theoretically discussed, special attention being drawn to the influence of the nature of the surface employed. The author's views as to the mechanism of the production of frictional electricity point to the possibility of a new explanation of the formation of storms. Corresponding experiments in the domain of voltaic electricity are discussed and further researches on the generation of frictional electricity by gases foreshadowed. Reference is made to the researches of Richards. [See Abstract 589 (1924).] E. F.

2589. *Surface Heat of Charging.* **L. Tonks** and **I. Langmuir.** (Phys. Rev. 29. pp. 524–531, April, 1927.)—Two methods are pointed out for calculating the theoretically necessary reversible heat development of absorption accompanying the charging of the surface of a conductor. One method depends on a new relation $\eta_{s_1} - \eta_{s_2} = k\mathrm{T}ln(\mathrm{A}_1/\mathrm{A}_2) + \epsilon\mathrm{P}_{21}$ between the surface heats, η_s, of the two surfaces, the A's of electron equations of the type $i = \mathrm{AT}^2\epsilon^{-b/\mathrm{T}}$ and the Peltier heat at the interface between the conductors. The other method consists of a comparison of the cooling effect of electron emission and the latent heat calculated from the temperature variation of emission. Experimental evidence points to $\eta_s = 0$ (nearly), A = 60·2 amps./cm.^{2} deg.^{2} (nearly) for all pure metals. Oxide coated filaments present a difficulty. For monatomic films the first method gives appreciable values of n_s, and experimental data for use in the second method are lacking. Stopping potentials of Na, K and Li yield further evidence that n_s is very small for all pure metals. The relation between the surface heat of charging and certain assumptions fundamental to electron emission theory is discussed.

AUTHORS.

2590. *Variable Elementary Charge.* **G. v. Gleich.** (Ann. d. Physik, 83. 2. pp. 247–254, June 8, 1927.)—The author's object is to show how the hypothesis of the variable charge or, more correctly, of the variable electrodynamic action of the elementary charge, would affect the model of the atom. The conclusion is that it leads to the same result as the hypothesis of mass variability. Entirely mathematical. [See Abstract 705 (1926).] E. F.

DISCHARGE AND OSCILLATIONS.

2591. *Gradient in the Positive Column of the Glow Discharge.* **A. Güntherschulze.** (Zeits. f. Physik, 42. 11–12. pp. 763–772, 1927. From the Reichsanstalt.)—As the results of these researches the following laws are established: The collective experiments on multi-atomic gases, H_2, N_2, O_2, H_2O, air, show that the dependence of the gradient on the current strength can be represented by the equation gradient $= Cl^{-2/3}/r^{1/3}$. The collective experiments on monatomic gases He, Ne, Ar, Kr, X, Hg, show that the gradient decreases more or less with increasing current strength, and the following equation serves: gradient $= C \,.\, l^0/r(1+a^i/r)$, according to which the gradient is independent of the free wave-length and is inversely proportional to the tube radius when by the variation of the tube radius i/r remains constant. The magnitude C is, with monatomic gases, chiefly conditioned through the ionising tension V_i and the atomic weight M of the gases. [See also Abstract 2359 (1927).] A. E. G.

2592. *Heats of Condensation of Positive Ions and the Mechanism of the Mercury Arc.* **K. T. Compton** and **C. C. van Voorhis.** (Nat. Acad. Sci., Proc. 13. pp. 336–341, May, 1927.)—The two most suggestive lines of approach to the problem of accounting for the current at the kathode of a mercury arc are based on considerations of space charge and of thermal equilibrium. In this paper is pointed out the significance of some recent work by Güntherschulze on evaporation and conduction heat losses from a kathode, and by the authors on heats of condensation of electrons and positive ions. These latter are important factors in the "energy balance" at the kathode, since the kathode is cooled by the emission of electrons from it and heated by the neutralisation of positive ions at its surface. From this study two very important conclusions in the theory of the mercury arc are arrived at: (1) Langmuir's theory that electrons are drawn out by the intense space charge field is correct; (2) the mercury lost by the kathode is in part lost in lumps or drops composed of numbers of atoms. A. E. G.

2593. *Action of Slow Kathode Rays on Rock-Salt.* **R. Frisch.** (Akad. Wiss. Wien, Ber. 136. 2a. No. 1–2. pp. 57–64, 1927.)—The experiments of Goldstein with fast kathode rays were repeated, and it was shown that the electrical conductivity of rock-salt was increased when it was coloured by this means. The possibility of this being due to metal particles from the kathode is discussed. With slow kathode rays no true coloration of the crystals was obtained; on the other hand, kathode fluorescence could be observed down to electron velocities produced by 30 volts in a tube with a Wehnelt incandescent kathode, and thermoluminescence down to 10 volts. The experiments with slow kathode rays were disturbed by a surface layer of deposit coming from the kathode. This was always produced at the place on which the electrons struck the rock-salt, even when these were magnetically deflected. H. N. A.

2594. *Loss of Energy of Slow Electrons by Collision with Molecules.* **W. Harries.** (Zeits. f. Physik, 42. 1. pp. 26–42, 1927.)—There is a loss of energy in the case of those electrons, the energy of which corresponds to a fall of potential of 5·2 volts, on collision with molecules of nitrogen and carbon monoxide. The experiments here described show that there is a total loss of energy for collisions with nitrogen molecules of 0·26 volt and of 0·83 volt for collision with CO molecules with each 100 collisions. The loss of energy is explained as caused by the inciting of oscillation quanta; an oscillation quantum being produced in nitrogen with about 110 collisions, in CO with about 31 collisions. The greater result with CO molecules is considered to be due to the dipolar character of the gas. A. E. G.

2595. *Ionisation Potential of Methane.* **E. Pietsch** and **Gertrud Wilcke.** (Zeits. f. Physik, 43. 5–6. pp. 342–353, 1927.)—From theoretical considerations regarding refraction a value of 9·5 volts was accepted for the ionisation potential of methane. Comparison with Ne, HF, H_2O, and NH_3 regarding association led to a different value, while comparisons with Kr showed many similarities and probably also for the ionisation potential. The authors obtained the value for methane experimentally using a steady flow of CH_4 past a glowing electrode. The results are set out diagrammatically and in a table, and this gives $14{\cdot}58 \pm 0{\cdot}05$ volts for the ionisation potential of the CH_4 molecule. In the investigation for hydrogen, an ionisation potential of $18{\cdot}22 \pm 0{\cdot}18$ volts leads to a value of $106{\cdot}7 \pm 4$ k. cal. for the dissociation energy of the H_2 molecule. R. S. R.

2596. *Ionisation by Collisions of the Second Kind in the Rare Gases.* **G. P. Harnwell.** (Phys. Rev. 29. pp. 683–692, May, 1927.)—A positive ray apparatus was used to investigate the products of ionisation by electron impact in mixtures of helium, neon, and argon. The variation with pressure of the ratio of the two types of positive ions present was investigated in detail for three cases. Case 1.—A mixture of half helium and half neon was investigated up to 0·15 mm. pressure. The ratio He^+/Ne^+ was found to decrease regularly between 0·03 mm. and 0·15 mm. At 0·03 mm. the mean free path is approximately equal to the dimensions of the apparatus. The suggested reaction is: $Ne + He^+ \rightarrow Ne^+ + He$. Case 2.—A mixture of half neon and half argon was investigated throughout the same pressure range. The ratio Ne^+/A^+ decreased regularly between 0·05 mm. and 0·15 mm., but this decrease was less rapid than that of the ratio in Case 1. The suggested reaction is: $A + Ne^+ \rightarrow A^+ + Ne$. Case 3.—This mixture was half helium and half argon, and the pressure range was the same as in the first two cases. The ratio He^+/A^+ remained constant within the limits of experimental error. Case 3A.—A mixture of 15 % helium and 85 % argon was also investigated, as there were theoretical grounds for believing that the rate of variation of He^+/A^+ with pressure would be greater in such a mixture. In that case the ratio He^+/A^+ was found to decrease slightly. The suggested reaction is: $A + He^+ \rightarrow A^+ + He$. The observed effects are best explained by a type of collision of the second kind which is equivalent to ionisation by positive ions. To account for the results obtained an electron must be transferred from an atom to an ion at a certain fraction of the collisions between an atom and an ion of higher ionising potential. The results obtained at low pressures corroborated the values for the probability of ionisation in these gases obtained by K. T. Compton and C. C. van Voorhis. AUTHOR.

2597. *Electron Current and Space Charge in Dense Gases.* **F. Skaupy** and **W. Daudt.** (Phys. Zeits. 28. pp. 313–315, May 1, 1927.)—Experiments are here described which show the dependence of the anode current on the grid tension for different anode tensions at pressures of 300, 400, 500, 600 mm. Hg in N_2, when the heated wire is kept at a temperature of 1875° C. about. A comparison with vacuum kathode tubes is given, as is also the effect of introducing a small quantity of CO_2 and of H_2 with the nitrogen. A. E. G.

2598. *Space Charge in High-Tension Technique.* **O. Mayr.** (Archiv f. Elektrot. 18. pp. 270–282, May 11, 1927.)—A theoretical investigation into the phenomena of brush discharges and coronas, assuming them to be ionisation phenomena. Special cases taken are (*a*) a cylinder placed coaxially within another, (*b*) two parallel wires, and (*c*) a wire parallel to a plate. An experimental investigation shows fair agreement with the theory developed. G. E. B.

2599. *Thermionic Emission from Iron-Alkali Mixtures used as Catalysts in the Synthesis of Ammonia.* **C. H. Kunsman.** (Frank. Inst., J. 203. pp. 635–646, May, 1927.)—Considerable interest is attached to certain thermionic investigations on account of the added information which may be obtained in regard to surface phenomena, mechanism of thermionic emission, ionisation, adsorption, and surface catalysis. A convenient source of positive ions of Cs, Rb, K, Na, Ba, Sr, Ca, and Mg is found. This source gives single positively charged ions under all conditions, with the absence of clustering. The source of ions is free from any marked change in the temperature of the surface, other than that predicted from Richardson's equation, in contrast to the positive ions obtained from their condensed films. The determined values of $\phi +$ and $\phi -$ for the surfaces throw further light on the mechanism of this emission. $\phi +$ is always less than $\phi -$ under all conditions. The effect of reducing the mixture and surface is to decrease $\phi -$ to about one-half the value for the unreduced surface without any appreciable change in $\phi +$. The probable significance of the thermionic studies in regard to surface catalysis is discussed. A. E. G.

2600. *Neutralisation of the Deflecting Field in a Braun Tube with External Electrodes.* **L. T. Jones** and **A. M. Cravath.** (Phys. Rev. 29. pp. 871–879, June, 1927.)—The field of the external electrodes is rapidly neutralised by the collection of ions and electrons on the tube walls so that the deflection is not simply proportional to the applied voltage. The neutralisation proceeds like the discharge of a condenser through a resistance for which the time constant is $RC = \tau$. This time constant τ, which is a reciprocal measure of the rate of neutralisation, was calculated from current measurements made with internal electrodes, together with the dimensions of the tube, and was also measured directly by photographing the variation of deflection with time, the respective values for a certain tube being 0·002 sec. calculated, and from 0·001 to 0·005 sec. measured under different conditions. The deflection of the beam is found as a function of τ and the applied voltage, and in particular the expressions for amplitude and phase of deflection for sinusoidal applied voltages are derived, the results being

$$D = V_0 S \cos\delta \sin(2\pi ft + \delta) \quad \text{and} \quad \delta = \cot^{-1} 2\pi f\tau,$$

where D is the beam deflection, V_0 the applied voltage, f the frequency, and S is a constant of the tube. AUTHORS.

2601. *An Application of the Vacuum-Tube Oscillator.* **C. B. Crofutt.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 431–432, May, 1927.)—A vacuum-tube oscillator is used in a Hartley circuit to obtain a steady source of vibrations with frequency which can be varied between 200 and 1,500,000 cycles per sec. The oscillator can be employed as a source of a.c. for bridge measurements and for radio measurements. It can also be used as a source of steady sound as required for the Kundt's tube experiment, in which a loud speaker replaces the usual metal rod. If the loud speaker acts on a brass tube provided with small holes and connected to a gas supply, the gas flames assume a wave form which is visible to a large class. G. E. A.

2602. *Three Experiments Illustrating Oscillation Phenomena.* **H. Sell.** (Zeits. techn. Physik, 8. 6. pp. 222–230, 1927.)—(1) Resonance is illustrated by the effect of a rhythmically-moving magnet on the glow produced round a tungsten wire in vacuum by alternating current; (2) an apparatus is described for showing (and also for measuring) the damping effect of a telephone receiver in the plate-circuit of a triode valve; (3) the damping effect of an air-chamber behind a light membrane is demonstrated by means of oscillograms. G. E. B.

2603. *Absorption of Radio Waves in the Upper Atmosphere.* **E. O. Hulburt.** (Phys. Rev. 29. pp. 706–716, May, 1927.)—Recent measurements have shown [see Abstracts 1438 and 2181 (1926)] that radio waves below 150 metres fall off in intensity faster than required by an inverse square law for distances up to 1000 miles. This points to absorption of the wave by the medium, in this case the upper atmosphere. The absorption of the waves variously polarised is calculated on the assumption that it results from collisions between the electrons and molecules of the atmosphere. With reasonable average values of the electronic and molecular densities the amplitude A of the wave λ cm. at a distance x cm. is $A = ax^{-1}exp(-11 \cdot 8 \times 10^{-16}\lambda^2 x)$, theoretically valid for waves from 16 to 160 metres to distances of 1000 miles. This agrees well enough with the scant range and intensity data, and it is pointed out that an extension of these data may lead to more exact knowledge of the overhead electronic and molecular pressures. From the absorption curves interesting possibilities appear of polarisation of waves in the broadcast band 200–600 metres. AUTHOR.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2604. *Electrical Conductivity of Solid Cuprous Bromide.* **P. Fischer.** (Zeits. Elektrochem. 33. pp. 170–172, May, 1927.)—The electrical conductivity of cuprous bromide was determined by employing a compressed cylinder 18·4 mm. long by 10 mm. diameter, made of the purest cuprous bromide possible. The results of the measurements confirmed the metallic nature of the conductivity of Cu_2Br_2. The specific conductivity of Cu_2Br_2 at ordinary temperature was found to be 0·044. The conductivity increased with the temperature. When silver or copper electrodes were employed, lower values were obtained for the conductivity. Mixtures of Cu_2Br_2 and KBr showed a maximum conductivity at a content of 10 % KBr. F. J. B.

2605. *Contact Resistance.* **R. Holm.** (Zeits. techn. Physik, 8. 4. pp. 141–154, 1927.)—Discusses contact resistance from the point of view of elastic contact between discrete particles, using the Hertz equations for the deformation of elastic spheres under pressure and "Hertzian surfaces" to obtain a macroscopical result. Experiments are described to determine the numerical values of various factors occurring in the theoretically obtained expression. [See Abstract 1903 (1926).] G. E. B.

2606. *Mechanism of Breakdown of Dielectrics.* **A. Joffé, T. Kurchatoff** and **K. Sinelnikoff.** (J. Math. Phys., Mass. Inst. of Technology 6. pp. 133–144, April, 1927.)—At high temperatures dielectric breakdown is due to heating by the current, as assumed by Wagner, and follows the laws given by Rogowsky and Semenoff. At low temperatures it is due to ionisation by impact. As soon as the maximum velocity v_0 reached by an ion satisfies the condition $1/2mv_0^2 = eP$, where P is the ionising potential, the current increases and a breakdown follows. The velocity v_0 is proportional to the electric field up to the breakdown point, therefore the condition for a breakdown potential at low temperatures is a definite electric field E. This field has to be corrected by taking into account the space charges produced in the dielectric. In thin sheets this condition does not hold. As the number of ionisations is small, no breakdown results and much higher fields may be obtained. A definite number of collisions is necessary in order to reach a breakdown, therefore the breakdown potential is independent of the thickness in sheets of 0·3 to 5 μ, the electric field being inversely proportional to the thickness and increasing for glass from 5×10^5 volts/cm. to 10^8 volts/cm. An ionisation current is observed in thin sheets, and its dependence on thickness, electric field and temperature satisfactorily checks the present ionisation theory. In sheets of less than 0·2 μ the breakdown becomes once more independent of thickness and temperature. Breakdown is in this case suspected to be due to a pulling out of ions by the field. The maximum field for glass is found to be about $1{\cdot}5 \times 10^8$ volts/cm. E. F.

2607. *Index of Refraction of Water for Short Continuous Waves.* **L. E. McCarty** and **L. T. Jones.** (Phys. Rev. 29. pp. 880–886, June, 1927.)—The index of refraction of water for short continuous waves (300 to 700 cm.) was measured from the phase difference resulting between two portions of a wave, one portion of which had passed through the dielectric. The phase difference was detected and measured by the rotation of the Lissajous figure formed on the screen of a kathode-ray oscillograph, due to the simultaneous action on the kathode beam of two tuned circuits receiving the two portions of the wave. The two circuits were attached to the opposite pairs of deflector plates of the oscillograph. The index of refraction was calculated from the relation $\mu = m\lambda/d + 1$, where λ is the wave-length, d the thickness of interventing dielectric in one path, and m the fraction of a period by which the wave passing through the dielectric is retarded relative to the one passing through air. The results are in good agreement with the electrical refractive index found by other methods—*i.e.*, about 9—and approximately constant over the range of frequencies used. Brief reference is made to a method by which it is hoped to measure the dielectric constant under conditions identical with those existing in the measurement of the index of refraction, to be used in conjunction with the latter, in testing Maxwell's relation between index of refraction and dielectric constant. AUTHORS.

2608. *The Dielectric Constant according to Wave Mechanics.* **R. Gans.** (Phys. Zeits. 28. pp. 309–313, May 1, 1927.)—Manneback has recently calculated [see Abstract 780 (1927)] the electric polarisation of a medium in an electric field according to the rules of wave mechanics. At the conclusion of that paper he adds that the consideration of electron displacement gives a physically impossible result in which the dielectric constant increases logarithmically with the temperature. In the present paper this is shown to be an error, and it is also shown that the Schrödinger theory gives a formula which for high temperatures might be expected according to statistical mechanics. A. E. G.

2609. *Changes in the Photoelectric Threshold of Mercury.* **H. K. Dunn.** (Phys. Rev. 29. pp. 693–700, May, 1927.)—C. B. Kazda [see Abstract 840 (1926)] has found the photoelectric threshold of a mercury surface cleansed of impurities by means of a constant overflow. In the present work his value of 2735 Å. for the threshold of clean mercury is checked. When the surface flow is allowed to stop in a high vacuum, some impurity attacks the surface, quickly raising the threshold to 2850 Å. If liquid air is not used, this impurity is present in larger amounts and attacks the running surface. Indications are that a surface film is formed and maintained in spite of the flow when liquid air is not used, or requires two hours or more for removal if liquid air is used. This impurity cannot be one of the gases with extremely low melting points. It is not water, but it may be a component of the stop-cock grease. When the surface is left standing several days in a high vacuum, its threshold falls to 2680 Å. If liquid air is not used, the standing surface has a limit of 2560 Å. All of these values are closely reproducible. Pure hydrogen in contact with the surface does not change the photoelectric behaviour. When the mercury is condensed in the presence of hydrogen, some of the gas is dissolved in the metal. This does not change the characteristic threshold of the mercury. It does, however, have the effect of greatly impeding the action of other impurities that form on the surface. This is indicated by the fact that over two hours are required for the change from the threshold of 2735 Å. for the clean surface to the maximum of 2580 Å., as compared with thirteen minutes for this change when hydrogen is not present. AUTHOR.

2610. *Piezoelectricity of Crystal Quartz.* **L. H. Dawson.** (Phys. Rev. 29. pp. 532–541, April, 1927.)—Experimental work is described in which quadrant-electrometer measurements are made of the distribution of the charge over the surface of a quartz crystal in a plane normal to the optic axis. The charges are found to vary in such a manner as to produce six regions of charge, three positive and three negative. These areas are definitely related to the electric axes. The piezoelectric effect is increased by about 20 % from room-temperature to 60° C., and then reaches zero at 573° C. The charge varied on different specimens, all specimens used being optically perfect. Numerical values were obtained in general agreement with those of P. and J. Curie. G. E. B.

2611. *The Hot-Wire Manometer.* **M. Knudsen.** (Ann. d. Physik, 83. 3. pp. 385–390, June 16, 1927.)—Describes a form of hot-wire manometer, which is more sensitive than any other manometer, and can be used for small pressure changes between 10 and 0·01 mm. Hg. A platinum Wollaston wire, 3 to 4 cm. long and 0·2 microns diameter, enclosed in a glass bulb, carries a current, which is regulated so that the resistance r has a constant value ; the result is that the mean temperature of the wire is always the same, and it is only necessary to measure the current i in order to determine ri^2, which through a considerable pressure-range varies linearly with the pressure. Gives details of the electrical circuit employed and of the method of calibration. H. N. A.

2612. *Measurement of the Vacuum in Electric Lamps.* **P. Selényi.** (Zeits. techn. Physik, 8. 6. pp. 230–235, 1927.)—Describes several methods of obtaining an estimate of the pressure of the residual gas in a vacuum lamp. All these depend upon the fact that when the lamp is alight the electronic current between the leading-in wires produces a stream of positive ions which increases in intensity as the pressure of the residual gas increases or, alternatively, as the electron current increases. If the lamp be nearly immersed in an electrolyte, and if an alternating voltage be applied to the filament as one electrode and the liquid electrolyte as the other, the lamp acts as the system of condensers shown in Fig. 1. C_K represents the pure capacity of the glass bulb, and C_F the capacity of the space between the filament and the inner surface of the bulb. R is the resistance of this space and decreases as the ion formation increases. The circuit used for the measurements is shown in Fig. 2. W is a measuring resistance, D a crystal detector and G a sensitive galvanometer. The frequency used is about 500 per sec. Other methods of making the measurement are described in the paper.

J. W. T. W.

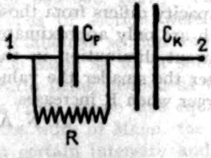


FIG. 1.

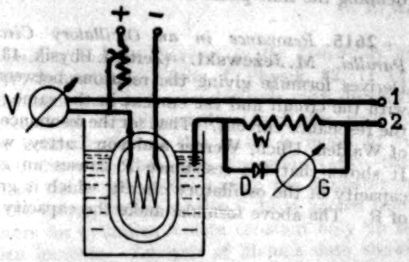


FIG. 2.

2613. *High-Frequency Resistance of a Bureau of Standards Type Variable Air Condenser.* **S. L. Brown, C. F. Wiebusch and M. Y.**

Colby. (Phys. Rev. 29. pp. 887–891; June, 1927.)—A method is described whereby the high-frequency resistance of variable air condensers is measured with an accuracy of 1%. Data are given showing the resistance of a Bureau of Standards Type 0·0035 $\mu\mu$f condenser at wave-lengths from 40 to 175 metres and at different positions on the scale. The values obtained range from 0·0283 ohm at 119 metres and 174° scale setting (range 0° to 180°), to 0·150 ohm at 63 metres and 20° condenser setting. The resistance increases rapidly towards the lower positions on the scale, and also increases with wave-length.

The resistance of single-turn coils of B and S No. 8, 2, 00, and 0000 annealed copper wire were measured at wave-lengths from 40 to 175 metres. These values were compared with the calculated values, and were found to check to within 2 % in most cases, and the discrepancies may easily be ascribed to experimental errors. AUTHORS.

ALTERNATING CURRENTS AND MAGNETISM.

2614. *Properties of the General Elliptical Rotating Field.* **G. Hauffe.** (Zeits. techn. Physik, 8. 6. pp. 243–244, 1927.)—It is shown that the angular velocity of the field resulting from the combination of two alternating fields, which are inclined to one another and which differ from one another in phase, is inversely proportional to the square of the instantaneous value of the field. This velocity is spoken of as the velocity of the general elliptical rotating field. It is shown that the surface covered in unit time by the field vector is constant. A circular rotating field results if two equal fields, with any time-phase difference, have directions such that the sum of the angle between them and the angle defining the time-phase difference between them is 180°. H. N. A.

2615. *Resonance in an Oscillatory Circuit with a Resistance in Parallel.* **M. Jeżewski.** (Zeits. f. Physik, 43. 5–6. pp. 442–448, 1927.)—Derives formulæ giving the relations between the resistance in parallel with the circuit and the current in the same, the resonance capacity and the resonance current. That for the resonance capacity differs from those of Walden, Ulich, Werner and von Lattey, which are only approximate. It shows that the resistance R causes an apparent diminution in the capacity of the oscillatory circuit, which is greater the smaller the value of R. The above formulæ make the capacity larger when R increases. H. N. A.

2616. *Magnetic Susceptibility of some Binary Alloys at High Temperatures, and their Equilibrium Diagrams.* **H. Endô.** (Tôhoku Univ., Sci. Reports, 16. pp. 201–234, March, 1927. In English. Report No. 146 from the Research Inst. for Iron, Steel and other Metals.)—Using method and apparatus as in a previous investigation [see Abstract 1466 (1926)], the susceptibilities of the pure metals used in preparing the binary alloys were measured at high temperatures, before measuring the susceptibilities of the alloys. The following conclusions are stated. A compound has a magnetic susceptibility characteristic of it. The susceptibility-concentration graph is rectilinear for a mechanical mixture, but curved in the case of alloys which form a solid solution. If a small amount of another element is contained as a solid solution in a strong diamagnetic element, such as bismuth or antimony, the susceptibility of the latter rapidly increases. Intermetallic compounds, which exist up to the liquidus point, are also present undecomposed in the liquid state, though some degree of dissociation is noticeable. G. E. A.

2617. *The Periodicity of Magnetic Disturbances at Parc Saint-Maur and Val-Joyeux.* **C. E. Brazier.** (Comptes Rendus, 184. pp. 531–532, Feb. 28, 1927.)—The observations analysed extend over about 35 years. The distribution in time is considered, not of magnetic storms, but of disturbed days, all being admitted which yield disturbances, no matter the intensity or duration. The method of grouping the results is briefly indicated. It is concluded that the maximum frequencies in order of duration are 13 days; 26, 27, 28 days; 52, 53 days; 74, 75 days; 81 days. The results show that disturbed days tend to follow one another at intervals approximately equal to that obtained by multiplying the period of rotation of the sunspots by a simple fractional factor lying between 0·5 and 3. A. A. D.

2618. *The Magnetic Properties of Vanadyl Chloride and Sulphate, and the Atomic Moment of Tetravalent Vanadium.* **N. Perrakis.** (Comptes Rendus, 184. pp. 1430–1432, June 13, 1927.)—The first substance, $V_2O_2Cl_4 + 5H_2O$, is a green viscous liquid with a coefficient of atomic magnetisation $+ 1016 \cdot 9 \times 10^{-6}$. The Curie point is displaced with change of temperature, and the atomic moment is 7·94 magnetons. The second substance, $VOSO_4 + 3\frac{1}{2}H_2O$, is a blue powder which, like the first, undergoes with change of temperature a displacement of the Curie point without change of moment. The atomic moment is 8·95 magnetons. The vanadium is tetravalent in both substances, and has at least two atomic moments, one of 8 and the other of 9 magnetons. G. E. A.

2619. *Demagnetisation Factors and the Increase in the Sensitivity of Schering's Magnetometer.* **W. Schneider.** (Zeits. f. Physik, 82. 11–12. pp. 883–898, 1927.)—The demagnetisation factors for rods with different types of section were determined experimentally. Both for rods of rectangular section and for hollow cylinders this factor is found to be the same as for a solid cylinder with the same dimension ratio—this ratio being defined as that of the length of the rod to the diameter of a circle whose area equals the corresponding section. As is known from the work of Mann, the factors for cylinders remain constant only up to a certain intensity and then increase. Analysis of Mann's data shows that $H^a\beta^b$ = constant, where H is the applied field and β the demagnetising factor. This equation holds for a given intensity, and when this is changed so are the constants. As saturation is approached a and b both approach unity. The second part of the paper deals briefly with the use of permalloy instead of soft iron in a magnetometer designed to measure the earth's vertical intensity. A. A. D.

2620. *Influence of Mechanical Actions and of Alternating Currents on the Discontinuity of the Magnetisation of Iron.* **S. Procopiu.** (Comptes Rendus, 184. pp. 1163–1165, May 16, 1927.)—Magnetisation of a ferromagnetic substance takes place in a discontinuous manner. This phenomenon has been established by the experiments of Barkhausen. The progressive magnetisation of a substance sets up induced currents which are due to the reversing of magnetisation of elementary parts in the irreversible branches of the cycles of magnetisation. Van der Pol and Forrer have found great discontinuity of magnetisation in the case of ferro-nickel and of nickel when submitted to a special treatment. The object of the present note is to point out two cases in which iron shows strong discontinuities of magnetisation, (1) by mechanical shocks, (2) by an alternating transverse magnetisation, obtained by making an alternating current traverse the bar of iron under observation. In the two cases the elementary magnetised particles are in a state of vibration which facilitates the reversings by the progressive magnetisation. A. E. G.

2621. *Crackling Noise when Iron is Magnetised.* **W. Arkadiew.** (Comptes Rendus, 184. pp. 1233–1234, May 23, 1927.)—Describes several simple methods of producing the noise noted by Barkhausen, in 1919, during the magnetisation of iron. The noise may be produced by a telephone diaphragm, and it is possible that the effect operates adversely during telephonic transmission. The effect may also be obtained from nickel wire prepared according to Forrer's method. [See Abstract 1978 (1925).] G. E. A.

2622. *Permeability of Iron at High Frequencies.* **C. Gutton** and **(Mme.) I. Mihul.** (Comptes Rendus, 184. pp. 1234–1237, May 23, 1927.)—Arkadiew found [Abstract 633 (1919)] the permeability of iron to vary irregularly within wide limits with change of frequency, whilst Laville obtained an almost constant value of μ for waves of length 3 to 87·5 metres [see Abstract 199 (1925)]. The authors confirm Laville's result, using a method in which the permeability is deduced from the resistance by means of Stefan's formula, viz.,

$$R = R_0[a\pi\sqrt{\mu c n} + \tfrac{1}{4}],$$

where R is the resistance at high frequency, R_0 that with steady current, a is the radius of the wire, c the conductivity, and n the frequency. The values of $\sqrt{\mu}$ found for two pieces of piano wire were about 8·2 and 6·9. G. E. A.

2623. *Some Experimental Methods in Magnetostriction.* **S. R. Williams.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 383–408, May, 1927.)—A synopsis of previous work and experimental methods on the subject of magnetostriction and its effects, to which is attached a complete bibliography. The subject is reviewed critically and is a report prepared to meet the demands of a worker preliminary to research on the subject. The report is threefold and deals with: (1) Mechanical strains due to magnetic stress, *i.e.*, the Joule effect, Barrett effect, Wiedemann effect, etc.; (2) magnetic streams due to mechanical stress, *i.e.*, Villari effect, Guillemin effect, Wertheim effect, Nagaoka-Honda effect, etc.; (3) allied phenomena, such as changes in resistance, thermo e.m.f., magnetic e.m.f., frequency change in magnetised tuning forks, Barkhausen effect, etc. The paper comprises an excellent *résumé* and analysis of the methods and technique employed on the subject. S. G. B.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2624. *Studies in Adsorption. Coagulation of Sols by a Mixture of Electrolytes and the Phenomena of Positive and Negative Acclimatisation.* **S. Ghosh** and **N. R. Dhar.** (J. Phys. Chem. 31. pp. 649–680, May, 1927.)—In a series of previous papers the authors have shown that more of an electrolyte is necessary to coagulate a dilute sol than a concentrated one, and that this is due to the appreciable adsorption of similarly charged ions from the coagulating electrolyte. The work is continued, and the coagulation of sols by mixtures of electrolytes was studied. Marked ionic antagonism was observed when ferric hydroxide aluminium and chromium hydroxides were coagulated by mixtures such as HCl and KCl, HCl and K_2SO_4, HCl and $K_3Fe(CN)_6$. These sols were stabilised in the presence of acids, owing to the preferential adsorption of similarly charged hydrogen ions by the sols of ferric aluminium, and chromium hydroxides. Sols of gamboge and gum dammar behave abnormally when coagulated by KCl and BaCl. The ionic antagonism is more marked with these sols than with mastic sol. Experiments on adsorption have been advanced supporting the conclusions of the authors and showing the inadequacy of the views of Freundlich, Bancroft, and Weiser on acclimatisation. The phenomenon of cutting down the adsorption of a precipitating ion due to the presence of another was shown to be, in all probability, a general phenomenon. Abnormal dilution effect, abnormal behaviour when coagulated by a mixture of electrolytes of widely varying precipitating powers, the phenomenon of positive acclimatisation, and the decrease in viscosity of a sol when small quantities of electrolytes are added are intimately connected and are mainly due to the adsorption of an ion on carrying the same charge as the sol. F. J. B.

2625. *Adsorption and Diffusion Phenomena in an Electrical Field.* **R. Fürth.** (Zeits. phys. Chem. 126. 3–4. pp. 238–246, April, 1927.)—The paper is a theoretical discussion of the work of J. Gicklhorn, R. Fürth and O. Blüh, which bears the same title [see Abstract 499 (1927)]. It is not possible to give a short abstract of the paper. F. J. B.

2626. *Behaviour of Solutions in a High-Tension Electrical Field.* **Z. Stary.** (Zeits. phys. Chem. 126. 3–4. pp. 173–195, April, 1927.)—The electrosmosis which takes place when solutions are exposed to high tension was investigated by using the electrodes made of paper strips, clamped between two heavy metal clamps. The solutions were KOH, NaOH, serum, and solutions of various dyestuffs. The voltage applied varied from 500 to 1250 volts. The results showed that water carried the dissolved substances to the kathode by electroendosmosis. F. J. B.

2627. *Migration Velocities of Colloids in an Electric Field.* **L. Engel** and **W. Pauli.** (Zeits. phys. Chem. 126. 3–4. pp. 247–266, April, 1927.)—Determinations of the migration velocities of colloidal ions from the movements of the boundary layers are found to be erroneous on account of electrophoresis. A similar error is obtained in measurements with electrolytes in a gel medium. An apparatus is devised in which the solution to be measured is contained in a central **U**-tube while contact is made with non-colloidal electrolytes in side tubes in which the electrodes

are immersed. In this way contact of the products of electrolysis at the electrodes with the solution under measurement is avoided. Determinations are made of concentration changes over a definite length of the tube, which can be closed by taps. The constancy of concentration of the main solution in the U-tube is ascertained by measurements of the electrical conductivity by means of small electrodes mounted in the bore of the tube. Migration velocities are measured of the I′ ion in KI solutions and of aluminium oxide and iron oxide sols in chloride solutions.
J. N. P.

2628. *Solubility and Diffusion of Hydrogen in Metals.* **G. Borelius.** (Ann. d. Physik, 83. 1. pp. 121–136, May 23, 1927.)—Consideration of the results of Sieverts [Abstracts 800 (1911), 474 (1916), 1045 (1917)], shows that the solubility c of hydrogen of pressure p in metals at high temperatures is given by the empirical equation, $c = ae^{-\beta/T}\sqrt{p}$, where β is a constant characteristic of the metal and a is a temperature function approximately constant for all metals at high temperatures. The assumptions that the penetration of metals by hydrogen is comparable with the passage of gases through porous materials, and that the boundaries of the metallic granules exert opposition to the penetration, explain the general form of Borelius and Lindblom's relation [Abstract 1245 (1927)] as well as the order of magnitude of $\sqrt{p_t}$ and its dependence on the temperature in the case of iron. The same assumptions lead to the relationship $m =$ constant cT, where m is the velocity of penetration. This relationship holds for iron and platinum, and at higher temperatures for palladium-platinum. Deviations therefrom are encountered with palladium-platinum at low temperatures and with nickel, and these are explainable by the assumption that only a part of the dissolved hydrogen atoms is freely mobile.
T. H. P.

2629. *Permeability of Nickel to Hydrogen Gas. Effect of Thickness of Metal.* **V. Lombard.** (Comptes Rendus, 184. pp. 1327–1329, May 30, 1927.)—In continuation of a research [see Abstract 1188 (1926)], the quantity of hydrogen is measured which penetrates nickel plates of different thicknesses at temperatures between 400° and 600° C. under a pressure of 770 mm. Taking d as the volume of hydrogen (reduced to N.T.P.), which traverses 1 sq. cm. in one hour, it is found that $d = K/h$, where h is the thickness of the plate and K is a constant for a given pressure and temperature.
G. E. A.

2630. *Permeability of Iron and Platinum to Hydrogen Gas.* **V. Lombard.** (Comptes Rendus, 184. pp. 1557–1559, June 20, 1927).—Dealing with discs of platinum and electrolytic iron, a law of diffusion of hydrogen through these metals is found similar to that obtained for nickel [see Abstract 1188 (1926)]. The gas passes through iron more rapidly than through platinum, but at about the same rate as through nickel.
G. E. A.

2631. *Quantitative Treatment of Deviations from Raoult's Law.* **J. H. Hildebrand.** (Nat. Acad. Sci., Proc. 13. pp. 267–272, May, 1927.)—Solutions which obey Raoult's law throughout the whole range of composition have been accepted as ideal solutions. The present author has shown that the deviations from this law at any one temperature are approximately proportional to differences of internal pressure. Following this line of work, the author developed equations which were tested by utilising the data given for sulphur in heptane, carbon tetrachloride, and benzene, and a constant was obtained over a considerable range of temperature. F. J. B.

2632. *Application of the Radiochemical Theory to Solutions of Sodium Iodide.* **R. Audubert.** (Comptes Rendus, 184. pp. 1440–1443, June 13, 1927.)—Repeating with solutions of sodium iodide the researches described in a previous paper [see Abstract 2176 (1927)], analogous results were obtained, thus justifying the conclusion that the radiochemical theory is applicable to the action of light on iodides. E. F.

2633. *Light-Scattering Capacity (Tyndall Effect) and Colloidal Behaviour of Gelatine Sols and Gels.* **E. O. Kraemer** and **S. T. Dexter.** (J. Phys. Chem. 31. pp. 744–782, May, 1927.)—The maximum light-scattering capacity (Tyndall effect) of a gelatine sol locates very exactly the *p*H value defining the isoelectric point; this may be from *p*H 4·8–5·5, according to the nature of the gelatine. Blended gelatines show a single intermediate isoelectric point. For de-ashed gelatine above 30° C. the Tyndall intensity indicates a high and constant degree of dispersion at all *p*H values between 2·7 and 12·2. Below 30° C. an abrupt change in Tyndall intensity occurs over a few fractions of a unit of *p*H at the isoelectric point, the merest trace of acid or alkali repressing the change. The simple theory of ampholyte solubility is not sufficient to account for the observed phenomena, and a discussion is given of the various theories as to the condition of gelatine in the sol state. B. W. C.

2634. *Coagulation of Gels.* **T. Mukoyama.** (Kolloid. Zeits. 42. pp. 180–183, June, 1927.)—Various modifications undergone by viscose solutions in the process of ageing have been previously dealt with. The subject of the present paper is a change of state resulting from two superimposed colloid-chemical reactions. According to the special physical and chemical conditions, viscose solutions, in the course of ageing, show two independent reactions: (1) Sol → gelatine → syneresis; (2) sol → flocculation. These lead, under certain conditions, to gelatinous flocculation, which is revealed by the separation of gel flocculæ. The entire solution may after a time become congealed, the gel flocculæ being visibly enclosed in the resulting gelatine. After longer standing syneresis supervenes and the gel flocculæ may still subsist in the solid "phase." This phenomenon is obviously the result of the differing speed of the two reactions, reaction 2, the first to occur, being overtaken in the later stages by reaction 1. Experiments, details of which are given in several tables, show that the smaller the cellulose content of the viscose solutions the sooner coagulation sets in, and that it occurs most rapidly with a medium alkali content (about 5 %). The changes of state are stimulated by the addition of glycerine but impeded by that of old to fresh viscose solution. [See Abstract 1914 (1927).] E. F.

2635. *Variations of the Space Lattice by Mixed Crystal Formation by Precipitation of Solutions.* **L. Vegard.** (Zeits. f. Physik, 43. 5–6. pp. 299–308, 1927.)—The work begun in a previous paper on the formation of mixed crystals of HgCl-HgBr, when a mercurous nitrate solution was precipitated by a mixed solution of KCl-KBr, is continued [see Abstract 2413 (1927)]. It was shown that the dimensions of the lattice underwent considerable variation for mixed crystals of the same composition but different conditions of precipitation. The law of additivity, put forward by the author, appeared to be a limiting case for extremely slow precipitation. The variations of the lattice are probably due to a considerable deformation of the mercurous ion, and can be explained as the action of a non-compensated atom on the surface, and consequently the deviations from the law of additivity increase as the size of the particles diminish. F. J. B.

2636. *Nature of Phosphorus Ionisation. Part II.* **W. Busse.** (Ann. d. Physik, 83. 1. pp. 80–120, May 23, 1927.)—The course followed by the formation of phosphorus ions [Abstract 819 (1927)] varies according as the temperature is rising or falling. In general, with rising temperature, the output of ions rises and, after passing through a more or less broad maximum, falls to about the initial value. Often several pointed or hump-like maxima appear, and with temperatures of 35° to 40° C. a slight point occurs shortly before ignition. Within certain limits, the maximum output is independent of the amount of phosphorus taken, and layers of moisture on the surface of the phosphorus play no part in the establishment of the maximum. In dry air formation of the ions occurs only at a higher temperature. When the temperature is falling, sometimes no maximum or but a slight one appears. There seems little doubt that the ionisation results from the dissociation of pyrophosphoric acid, for which the energy conditions are highly favourable. T. H. P.

2637. *Photochemical Equilibrium in Nitrogen Peroxide.* **R. G. W. Norrish.** (Chem. Soc., J. pp. 761–775, April, 1927.)—Observations on the pressure increase brought about when nitrogen peroxide in a quartz vessel is exposed to illumination from a mercury arc lead to the conclusion that a bimolecular photochemical decomposition of the gas takes place according to the equation $2NO_2 \underset{\text{dark}}{\overset{\text{light}}{\rightleftharpoons}} 2NO + O_2$. When the illumination is cut off after equilibrium is attained, the pressure gradually diminishes almost to that obtaining before the exposure, owing to the recombination of nitric oxide and oxygen. The effect of adding nitric oxide or oxygen supports the theory, since in each case the observed increase of pressure on illumination is equal to that calculated from the mass action law. The mechanism suggested is the activation of one molecule of nitrogen peroxide, which then reacts with an unactivated molecule to give two molecules of nitric oxide and one molecule of oxygen. A small secondary increase in pressure is due to the heat of combination of nitric oxide and oxygen and to the absorbed radiation. The photochemical decomposition of nitrogen pentoxide in presence of nitrogen peroxide [see Daniels and Johnston, Am. Chem. Soc., J. 43. 72, 1921)] is explained as follows: $2NO_2 \rightarrow 2NO + O_2$ and $N_2O_5 + NO \rightarrow 3NO_2$. L. M. C.

2638. *Chemical Activity of Slow Electrons.* **E. Rabinowitsch.** (Zeits. Elektrochem. 33. pp. 185–188, May, 1927.)—The relation is investigated between the critical electron velocity of a discharge which is required to decompose refractory oxides by bombardment and the heats of formation of the oxides. A thoria-coated tungsten wire is employed as kathode in a discharge tube exhausted to 10^{-6} mm. pressure. A platinum plate coated with calcium oxide is employed as anode, and potentials of from 5 to 40 volts are applied between the electrodes. Measurements of gas evolution are made with and without the applied field. The amount of decomposition of the calcium oxide is found to be negligible at the highest of these low voltages. High electron velocities are then applied by employing kathode rays obtained by a Coolidge kathode in a spherical glass vessel. Potentials of from 500 to 8000 volts are applied and the oxides of calcium, thorium, cerium, and zirconium employed. At a potential of 1000 volts, oxygen is liberated from the oxides of the rare earths, but the amount is only about 0·25 % of that corresponding to the Faraday equivalent. On account of this low yield and the difficulty of controlling the potential, a determination cannot be made of the critical electron velocity necessary to cause decomposition. J. N. P.

2639. *The Glow Test for Metals of the Platinum Group.* **C. W. Davis.** (Frank. Inst., J. 203. pp. 679–699, May, 1927.)—The original test described by Curtman and Rothberg [Am. Chem. Soc., J. 33. p. 718, 1911] is not an infallible test for the platinum group metals in the presence of copper, nickel or cobalt. After a discussion of the theory of contact catalysis and the factors influencing the glow reaction, a modified procedure is described which makes the method a more reliable test for the platinum group. B. W. C.

2640. *Ionisation Obtained by Bubbling Air through Various Solutions.* **C. R. Pitts.** (J. Phys. Chem. 31. pp. 693–702, May, 1927.)—The ionisation obtained by bubbling air through solutions of the sulphates, oxalates, halogen salts, nitrates, acetates of most of the common metallic elements, was studied. Air was bubbled through the various solutions, and the issuing air was allowed to strike an electrode which was connected to a quadrant electrometer. The ratio of positively charged ions to those negatively charged was calculated. The ratio +/− depended on concentration, and the effect of concentration was studied for aqueous solutions of NaCl. From the curve it was possible to determine the amount of salt to make an aqueous solution of NaCl electrically neutral. F. J. B.

2641. *Electromotive Behaviour of Arsenic-Arsenious Acid Solutions.* **F. Foerster** and **H. Pressprich.** (Zeits. Elektrochem. 33. pp. 176–181, May, 1927.)—In determining the equilibrium potentials of arsenic-arsenious acid solutions with the small addition of iodine ions, as recommended by Loimaranta [Abstract 545 (1907)], values correct for the concentration are obtainable only if the acidity of the solution is at least that of normal hydrochloric acid solution. For such solutions the formula

$$\epsilon_h = \epsilon_o + 0\cdot029 \log \frac{C_{H_3AsO_4}}{C_{H_3AsO_3}}$$

gives the value $\epsilon_o(18° \text{C.}) = +\,0\cdot574$ volt, in agreement with the value, $\epsilon_o(25° \text{C.}) = 0\cdot575 \pm 0\cdot002$ volt, calculated by Luther from the constants of the equilibrium $H_3AsO_4 + 2H^{\bullet} + 3I' \rightleftarrows H_3AsO_3 + I_3' + H_2O$, with increasing acid content of the liquid, the potential rises to more noble values, to the same extent as for hydrochloric and perchloric acids. T. H. P.

2642. *Theory of Electrolytes. Part II.* **L. Onsager.** (Phys. Zeits. 28. pp. 277–298, April 15, 1927.)—A mathematical treatment is given of the ionic forces which determine the properties of strong electrolytes. Expressions are derived for the equilibrium conditions with ionic forces; the distribution function; the general form of the stationary condition; the mobility of the ions; the electric field of the ionic atmosphere when in equilibrium; the forces on the ions during the passage of current; and the migration velocities of the ions in simple electrolytes. The relation derived by Debye and Hückel between conductivity and concentration is modified by taking into account the influence of Brownian movements on the ionic atmosphere. An equation is obtained of the form $l_i = l_i^0 - \alpha_i \sqrt{\mu}$, where l is the mobility and μ the equivalent concentration. This differs from the Debye and Hückel relation in that α is derived from the limiting mobility l_i^0, which is calculated from the ionic radius. An expression applicable to the conductivity of dilute aqueous electrolytes reduces to the form $\Lambda = \Lambda_0 - \alpha\sqrt{\mu} - \frac{\Lambda_0}{k}\mu$, where k is the dissociation constant. By considering the influence exerted by the ionic charge on electrophoresis, the theory further enables a calculation to be made of the effect of concentration on the transition numbers of ionic pairs. The expressions derived are tested by data from a number of different electrolytes. J. N. P.

2643. *Apparent Diameters of the Ions in the Debye-Hückel Theory of Strong Electrolytes.* **T. H. Gronwall.** (Nat. Acad. Sci., Proc. 13. pp. 198–202, April, 1927.)—The average of the apparent diameters of the two ions of a symmetrical salt is proportional to the second term in the expansion, in powers of the square root of the ionic concentration, of the osmotic coefficient or of the logarithm of the activity-coefficient of either salt or solvent. The abridged calculations yield sometimes values which are either unreasonably small (potassium nitrate and iodate) or even negative (thallium chloride and nitrate). To account for this discrepancy, Bjerrum has proposed formulæ based on ionic association. The author shows mathematically that all the values are positive and increase as expected when the higher order terms are retained. Figures are given for aqueous solutions of the salts mentioned. H. B.

2644. *Activity Coefficients of Small Ions.* **H. Müller.** (Phys. Zeits. 28. pp. 324–333, May 1, 1927.)—The Debye formula for the relation between conductivity and concentration of strong electrolytes is held to be inapplicable to small ions on account of the high potential field in the neighbourhood of these ions whereby the dielectric relation employed becomes untenable. An approximation which is employed in the derivation of the formula is shown to be inapplicable for small values of r, and while still employing the basis of the Debye theory, a more rigorous mathematical deduction is made of the factors determining the interionic forces. An expression derived to show the relation between the activity coefficient f and the concentration c is given by the equation $-\log f = (\alpha + \beta/a^4)\sqrt{c}$, where α is the gradient of the Debye limiting curve, (*i.e.*, 0·501 for monovalent electrolytes), a the mean ionic diameter and β is a constant. Curves are given for a number of electrolytes to show the relation between $-\log f$ and $\sqrt[3]{c}$ and between $-\log f$ and $\sqrt[2]{c}$ using the Debye relation and the revised formula. Agreement is shown to exist between the two formulæ for ionic radii greater than about 4 Å. [See also Abstract 1686 (1926).] J. N. P.

2645. *The Hydrate Problem. Part VI. Transference of Water in Solutions of Organic Electrolytes.* **H. Remy** and **H. Reisener.** (Zeits. phys. Chem. 126. 3–4. pp. 161–171, April, 1927.)—The results are given of determinations of the electrolytic transference of water in N-solutions of the chlorides of a number of organic bases. The regular dependence of the charge on the radius of particles observed by Hevesy (Jahrb. Radioakt. u. Elektronik, 11. p. 419, 1914; 13. p. 271, 1916; Kolloid Zeits. 21. p. 129, 1917), and the results of the investigations of Lorenz [Abstract 986 (1917)] indicate that salts with organic kations should exhibit lower water transference than the corresponding salts with equivalent elementary inorganic kations. The results of the authors' measurements are in agreement with this conclusion, the water transference being negative in all the solutions examined, whereas in equally concentrated solutions of univalent metals positive values are always obtained. T. H. P.

2646. *Electrolytic Oxidation of Concentrated Formic Acid Solutions.* **F. Müller.** (Zeits. Elektrochem. 33. pp. 173–176, May, 1927.)—As was found by Fischer and Krönig [Ges. Abh. d. Kohle, 7. p. 244, 1925], in the electrolytic oxidation of concentrated formic acid solutions under small current densities, little or no gas is evolved at the anode. This is now found to be due to the fact that a portion of the carbon dioxide formed is not liberated in the gaseous state, but remains in solution, being far more soluble in formic acid or formate-formic acid solutions than in water. The amounts of carbon dioxide and hydrogen actually formed during the electrolysis are in accordance with the equation: $2H.CO_2H + 2F - 2F \rightarrow H.CO_2H + H_2 + CO_2$. T. H. P.

2647. *Oxidation of Alkali Plumbite to Plumbate by a Sine Alternating Current.* **F. Jirsa** and **F. Kornalik.** (Zeits. Elektrochem. 33. pp. 192–196, May, 1927.)—When electrodes resistant to sodium hydroxide solution are used, alkali plumbite is oxidised to plumbate by electrolysis. The current-yield of PbO_2 depends on many factors and is very small with electrodes of gold or cadmium, larger with palladium, and best with nickel. With palladium electrodes the yield rises with the current density for all concentrations of alkali hydroxide, and for a constant current density the yield increases as the strength of the alkali rises to 1·5 N and then diminishes rapidly. With nickel electrodes the current yield falls as the alkali concentration rises to 1·5 N–NaOH, then increases to a maximum at 4·5 N, and afterwards diminishes again. The curve for nickel is completely antibasic to that for palladium. When platinum electrodes are used, no oxidation to plumbate occurs, but the platinum is oxidised by the anode components to PtO_2, which is then reduced to PtO by the kathode components. The instability of platinous salts, expressed by the equation, $2Pt^{\cdot\cdot} \rightleftarrows Pt + Pt^{\cdot\cdot\cdot\cdot}$, is employed to explain the fact that the products of the electrolysis of plumbite by means of alternating current applied at platinum electrodes contain metallic platinum, and both PtO_2 and PtO, the last being probably combined with lead oxide as platinite. The yield of plumbate falls as the periodicity of the current increases. T. H. P.

2648. *Coating Aluminium, Magnesium, Light and Ultra-Light Alloys.* **J. Cournot, J. Bary** and **E. Pérot.** (Comptes Rendus, 184. pp. 1172–1174, May 16, 1927.)—Continuation of previous researches [see Abstracts 1202, 1227 (1927)]. (1) Cementation of aluminium with copper. Varying the duration of the electrolysis from 8 mins. to 2 hrs. 40 mins. and the current from 1 to 0·055 amp., it was found that below about 0·7 amp. the penetration was not affected, but above that limit, the adhesion of the initial deposit being imperfect, no diffusion was produced. (2) Cementation of aluminium and duralumin with ferrochromes. Three ferrochromes were employed: the electrolytic (C = 0·11, Cr = 60·64), another slightly carburetted (C = 1·32, Cr = 64·14), the third highly carburetted (C = 7·41, Cr = 64·17). No penetration was obtained in pure aluminium, even after careful scouring and heating for 6 hrs. at 600° C. Repeating the experiment with an initial deposit of iron, the same negative result was observed. But with duralumin, even without the preliminary iron coating, there was rapid penetration after heating for 1 hr. at 580° C. The activity of the ferrochrome is in inverse ratio to its carbon content. Expectations of an increase in hardness were not realised. (3) Electrolytic coating and cementation of magnesium and ultra-light alloys. Attempts at coppering magnesium and magnesium-copper alloys gave no satisfactory result owing to the difficulties of initial scouring. Chemical scouring seems impossible, the electrolytes corroding or oxydising the magnesium. Cleaning with sand was tried, followed by immediate and rapid electrolysis. After sanding, the test pieces were at once immersed in a basic coppering bath with a current of 6 to 8 amps. per square decimetre. After an immersion of 5 mins. they were washed and plunged into an acid coppering bath till a suitable deposit was obtained. The coating seemed perfectly adhesive, but the microscope revealed defects due to minute particles of sand left by the mechanical scouring. On moistening these with water there was an immediate evolution of hydrogen. These defects persist even after a second coating, *e.g.*, of cadmium, on the copper.
E. F.

2649. *Special Cementations of Aluminium and Duralumin after a Double Electrolytic Deposit.* **J. Cournot** and **E. Pérot.** (Comptes Rendus, 184. pp. 1250–1252, May 23, 1927.)—Following on previous researches [see preceding Abstract and 1202, 1227 (1927)], the object of these experiments was the superficial production by cementation of complex alloys after successive electrolytic deposits of two different metals. The first deposit consisted of copper, the second of nickel, chromium, cobalt or cadmium. The test pieces, cylinders 8 mm. in diameter, were heated in a sand bath or in the neutral atmosphere of a tubular electric furnace. The following results were observed: (1) Outer appearance after cementation. At temperatures above 575° C. the surface is almost always wrinkled. It is easier to get a perfect surface by heating in the sand bath, probably because the test piece is better supported, and by effecting the cementation in two stages. (2) Micrographic appearance. Concentration in two stages seems equally favourable in this respect. The total penetration is regulated chiefly by the copper, the second deposit having little effect. We distinguish in the cemented zone: (*a*) A solid solution forming the basis; (*b*) a eutectic structure, of small quantity and analogous to that of Al-Cu alloys, arranged in a network round the crystals of the solid solution; (*c*) one or two hard constituents which remain in relief after polishing. Strongly marked spicules were found with cadmium, which appears to form two combinations with copper. The micrographic results are difficult to interpret, but these experiments seem to show that complex cementations may throw some light on special surface properties. Details of the tests are given in a table. E. F.

2650. *Nature of the Discharge during the Anode Effect.* **V. Schischkin.** (Zeits. Elektrochem. **33.** pp. 83–91, March, 1927.)—During the electrolysis of fused cryolite with varying proportions of alumina and of the chlorides of sodium, barium, and calcium employing carbon anodes three distinct stages may be recognised in the relation between current and voltage. At low values the current rises only slowly with increase of voltage, while breaks denoting more rapid rise of the current with voltage occur in the ranges 20–25 volts, 40–50 volts and 60–100 volts. This last break accompanies the so-called anode effect and is characterised by the formation of a brilliant arc. At the lowest break at 20–25 volts small sparks are observed and attributed to the glowing of portions of the anode which are not wetted by the electrolyte on account of the formation of a film of gas round the electrode which partially insulates the electrode from the main body of the electrolyte. At higher voltages the sparks develop into small arcs which lead to an uninterrupted ionic or electronic discharge. At a still higher voltage the silent discharge changes into a brilliant arc. With alumina in cryolite an equation is derived which expresses the critical current density for the anode effect in terms of the concentration of alumina. Effects similar to the above may be produced in aqueous sulphuric acid solutions. [See also Abstract 169 (1924).] J. N. P.

2651. *Electrolysis without Electrodes.* **O. M. Corbino.** (Accad. Lincei, Atti, **5.** pp. 377–379, March 20, 1927.)—Experimenting on the lines of Gubkin's researches [Ann. d. Physik, **32.** p. 114, 1887], the author investigated the electrolytic process in the case of an arc between carbon and liquid, of a glow discharge at ordinary pressure between a kathode consisting of an incandescent filament of platinum coated with oxide and the liquid, and of a glow discharge at low pressure with a cold kathode. Where the liquid consists of a metallic salt (*e.g.*, copper sulphate) minute metallic granules are deposited, but only in the case of the arc do they attain a sufficient volume to form a powder, which falls to the bottom of the receiver during the experiment. With a continous discharge at low pressure and small current intensity, however, the formation of granules is not perceptible during the experiment, but the liquid becomes turbid and in time deposits an impalpable metallic powder. Similar results were obtained with a solution of silver nitrate. A 1 % solution of gold chloride gave the same powdery deposit as other metals, but with a 1 % solution there is slight turbidity and a change in colour, even after filtration, showing the formation of colloidal gold. Examination with the ultramicroscope revealed numerous granules with lively Brownian movements. Still more unexpected is the result obtained with a liquid consisting of an ordinary gilding bath of gold chloride and potassium cyanide. In this case there is total absence of the metallic gold deposit, electrolysis being evidently produced with evolution of hydrogen at the contact between the column of discharge and the liquid. Nor is this due to low pressure on the liquid, seeing that in the same conditions the kathode, if immersed, becomes covered with the gold deposit. It is thus seen that the absence of a metallic electrode changes not only the form of the kathode deposit, which may assume a colloidal state, but also the chemical process of electrolysis, as is shown by the liberation of hydrogen, together with the ordinary gold deposit in the case of the gilding bath. This deposit is the result of a secondary reaction which no longer takes place if the kathode is not immersed in the solution. E. F.

2652. *Elimination of Ash and Impregnation of Wood Electrically.* **H. Bechhold** and **E. Heymann.** (Zeits. Elektrochem. 33. pp. 161–170, May, 1927.)—By passing a direct current through wood from electrodes clamped at the ends around which a supply of water is maintained, and removing the products of electrolysis by renewing the water, the wood can be obtained practically free from ash. The action is due in part to migration of the electrolytes whereby salts are replaced by their acids and partly to electrical endosmose. The removal of the salts diminishes the swelling power of the wood by adsorption of water and lessens the liability to fungus and bacterial growth. Experiments are made on the impregnation of wood by copper sulphate, mercuric chloride and ferric chloride, which is found to be possible through electroosmotic action. The migration velocities are found to vary very largely with the adsorbability of the individual ions. Determinations are made of the distribution of impregnating substance between pith and sap. J. N. P.

2653. *Electrolytic Deposition of Chromium from Chromic Acid Solutions.* **J. Stscherbakow** and **O. Essin.** (Zeits. Elektrochem. 33. pp. 245–252, June, 1927.)—Discussing previous work with special regard to E. Müller [Abstract 2994 (1926)] the authors find that pure solutions of CrO_3 are not reduced by the current before anions (sulphuric acid, sodium sulphate) are added, which for a time favour electrolysis and also oxidation. The possibility of a strong evolution of hydrogen (70 % in terms of the current) from concentrated CrO_3 solutions indicates the formation of a more or less porous, non-conducting film (Müller) on the kathode. When the electrolysis is taking place without a diaphragm, this film is invisible; it becomes visible on separating the anode and kathode by a diaphragm. The film, which is due to colloid formation in the electrolyte [see Liebreich, Abstract 1821 (1922)], is permeable to hydrogen; but it is pressed cataphoretically on the kathode and becomes impermeable to $Cr^{\cdots}$ so that the chromium yield diminishes. In order to suppress the appearance of this colloid and to work at high current density, the volume current density should be kept low, or the electrolyte be stirred, or the current be intermittent. [See also Abstract 2993 (1926).] H. B.

2654. *Influence of Gelatine on the Deposition Potential of Zinc.* **N. Isgarischew** and **P. Titow.** (Zeits. Elektrochem. 33. pp. 211–212, June, 1927.)—The authors agree with Rabald [Abstract 2495 (1926)] that the addition of gelatine to zinc sulphate raises the deposition potential of zinc; but they differ as to the optimum concentration of gelatine, which is a highly complex colloid of variable properties. In a hydrogen atmosphere the potential can be kept constant for several days. Other peculiarities are also discussed, *e.g.*, a minute drop of mercury penetrating into the cell settles apparently as a speck on the kathode and disturbs the electrolysis and polarisation. H. B.